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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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SATURDAY, JULY 4, 1925.

CONTENTS.

International Science.

ONE of the most important developments of scientific activity during the latter half of the nineteenth century was the promotion of the exchange of scientific ideas between different countries by means of international associations. Some of these were congresses which met at intervals of three or four years, when scientific communications were read and discussed, and, what was of still greater importance, an opportunity was afforded for those engaged in similar studies to make each other's acquaintance and understand each other's point of view. Some associations were, on the other hand, more especially concerned to secure the co-operation of different nationalities in carrying out observations of particular natural occurrences on a uniform plan, or with standardised instruments, so that the results could be discussed as a whole and no portion of the field of work should be entirely neglected.

The outbreak of War in 1914 caused an abrupt interruption to this friendly intercourse, which had up to that time exercised a very favourable influence in the progress of science. On the occasion of previous hostilities, the conclusion of peace was always followed by a renewal of scientific *camaraderie*, but this did not occur after the last and most disastrous of wars. The policy of the High Military Command of the Central European powers in waging war with a rigour previously unknown in modern times had imported unprecedented bitterness into the struggle; moreover, it must be remembered that, for the first time, scientific men themselves were brought into the conflict instead of continuing quietly to work in their laboratories, and maintaining correspondence with those of other nationalities, as was formerly the case. It is not surprising, therefore, that when the War was over many scientific workers in the allied countries hesitated

to renew the relations that had previously existed, even though it seemed scarcely just to make their former scientific colleagues responsible for the conduct of their countries' military chiefs.

The subject was discussed at an Inter-allied Conference of men of science held in London in October 1918, about a month before the Armistice, and resolutions were passed. The most important, Article I., was in the following terms: "It is desirable that the nations at war with the Central Powers withdraw from the existing conventions relating to International Scientific Associations in accordance with the statutes or regulations of such Conventions respectively as soon as circumstances permit, and that new associations deemed to be useful for the progress of science and its applications be established without delay by the nations at war with the Central Powers, with the eventual co-operation of neutral nations."

A further conference was held at Paris towards the end of November 1918, when details were discussed and an executive committee appointed to prepare a scheme. As a result, an International Research Council was convened at Brussels in July of the succeeding year, and definite statutes of convention were adopted. In these the purposes of the International Research Council are declared to be (*inter alia*): (1) To co-ordinate international efforts in the different branches of science and its applications. (2) To initiate the formation of international Associations or Unions deemed to be useful to the progress of Science *in accordance with Article I. of the resolutions adopted at the Conference of London, October* 1918.

It is the incorporation of Article I. that determines the present character and policy of the International Research Council and the Unions formed under its auspices.

A list is given of the countries "that may participate in the formation of the International Research Council and of any Scientific Union connected with it, or join such Union at a subsequent period." It corresponds to the countries and dominions which were at war with the Central Powers, except that it includes Greece and Poland, and omits Russia and the new Baltic Powers. It then provides that, after a Union or Association is formed, "nations not included in the above list, but *fulfilling the conditions of Article I. of the resolutions adopted at the Conference of London*, and diplomatic Protectorates of the enumerated countries may be admitted either at their own request or on the proposal of one of the countries already belonging to the Union. . . . A favourable majority of not less than three-quarters of the countries already forming part of the Union shall be required for admission. . . . The statutes of the Unions formed by the International Research Council require the approval of this Council." Later, Czechoslovakia and a number of neutral countries, including Denmark, Norway, Holland, Sweden, and Switzerland, were invited to join the International Research Council and the scientific organisations attached to it.

As we have seen, the provision for the admittance of new countries refers only to the Unions, not to the Council itself, but it has in practice been assumed to apply to the Council. In an amendment to the constitution proposed by the Executive Committee this has been explicitly provided.

The meetings of the General Assembly are held, as a rule, once in three years. The last meeting was held in 1922, and the next will be on July 7 in the present year. At the meeting in 1922 it was resolved "that only countries which have adhered to the International Research Council are entitled to be members of the Unions connected with it."

The stringency of the exclusion of the men of science of former enemy countries is consistently maintained in the statutes of the Unions formed under the International Research Council. A rule, which is, it is believed, common to them all, provides that "the President of the Executive Committee [of the Union] may invite to a meeting of the General Assembly [of the Union] scientific men who are not delegates, *provided that they are subjects of one of the adhering countries.*" It is at the General Assembly of a Union that scientific questions are considered, but no man of science, however eminent, is allowed to join in the discussion, or even to be present, if he belongs to one of the nations with which the Allies were formerly at war,—and this after seven years of peace.

From the first there were many scientific men among the allied nations who objected to these stringent measures of exclusion, and as time passed their numbers have increased. Geology has not only refused to form a Union under the International Research Council, but, at the Congress in Brussels in 1922, adopted an independent constitution, without any provision for excluding subjects of the Central Powers; and a meeting will be held under it in Madrid in 1926. The International Mathematical Congress that was to have been held in the United States in 1924 was abandoned because in that country "neither scientific co-operation nor financial support were in sight for a congress under the rules of the International Research Council." A meeting was, however, held in Canada, when the American Section of the Union passed a resolution requesting the International Research Council to consider whether the time was not ripe for the removal of the restrictions on membership now imposed by the rules of the Council. The London Mathematical Society has

refrained from attending this meeting, as well as that preceding it at Strasbourg.[1]

In view of the forthcoming meeting of the International Research Council, the Australian National Research Council has asked that this question shall be reconsidered. The Royal Academies of Science of Holland, Denmark, and Sweden, and the Société Helvétique have definitely purposed to amend the statutes by omitting all references to Article I. of the Resolutions of the Conference of October 1918. This change would, it is presumed, permit any nation to be admitted to the International Research Council and the scientific organisation attached to it on a vote of a majority of not less than three-quarters of the countries already included. Switzerland, however, would, by an additional provision, confine the privilege to countries forming part of the League of Nations.

Holland and Denmark wish, on the other hand, to rescind the provisions of the addition to the statutes in 1922, and thus permit a country to be admitted to a Union without previous admission to the Council. The Executive Committee will not support this proposal, but suggests an amendment, providing that a country which has joined the International Research Council has the right to be admitted to the Unions connected with it.

It is to be hoped that the International Research Council will not maintain the present exclusion of subjects of the former enemy powers; for we believe that this position is opposed to the wishes of the vast majority of the scientific men of the allied countries, and, needless to say, to the unanimous convictions of those of neutral lands.

If the Swiss amendments are carried, no distinction will remain between allies, enemies, or neutrals. The only condition of admittance will be membership of the League of Nations and the vote of the Council. This would permit of the admission of Austria at once. Germany would probably be eligible in a few months, but would have to wait for actual admission until the next General Assembly three years hence, unless of course she could be admitted conditionally on her joining the League of Nations. Russia would presumably be excluded, as she is not likely to join the League.

The simplest course would undoubtedly be to leave the question of admission to the uncontrolled discretion of the International Council, retaining, if it is thought desirable, the necessity of a three-quarters majority for a favourable decision. We are hopeful that the General Assembly at Brussels next week will alter a situation which is both unsatisfactory and unreasonable.

[1] Reference may also be made to the letter on this subject by Prof. G. H. Hardy, president of the National Union of Scientific Workers, published in some leading daily newspapers on May 30, 1924.

College Courses and University Examinations.

A BOLD policy has been adopted by the Senate of the University of London with the view of solving one of the oldest and most difficult questions in relation to the organisation of University education in London—the question of establishing a close association between college courses of study and the examinations for university degrees. The college selected for this experiment is the Imperial College at South Kensington, comprising the Royal College of Science, the Royal School of Mines, and the City and Guilds (Engineering) College. Of these Colleges, the Royal College of Science has always adopted a distinctive method of training its students, based on the intensive study of one subject at a time. The impracticability of completely adjusting the degree examinations of the University to this system of training, conjoined with a general desire on the part of the College for freedom in framing curricula, led to a prolonged and somewhat embittered controversy between the College and the University, in the course of which the College authorities adopted the extreme measure of applying for the status of a separate University. This failed, as other attempts of the kind had previously failed; but the fundamental problem remained unsolved.

The history of the controversy as to relating University examinations to college teaching is as old as the University itself. Established by Royal Charter in 1836 for the purpose of examining for academic degrees students of University College, King's College, and other affiliated colleges, the University in course of time adopted an attitude of aloofness to all colleges, though it was no part of the original conception of the University of London, as the Selborne Commission pointed out, that it should be a mere examining body, without any direct connexion with teaching institutions. In those early days great importance was attached to the independence of the examining authority. University College welcomed the Royal Charter for the University, on the ground that the professors of the College would not have to confer degrees on their own students. There were, however, some connected with the College who raised the objection that the examinations would interfere with the independence of College teaching, both by determining the course of study and by affecting the method of instruction; and the College manifesto admitted that "this argument has weight." It is a tribute to the fairness and efficiency of the University examinations that this objection was not pressed for so many years. In 1884 the "Association for Promoting a Teaching University for London" was formed. This was the

first step leading to the reconstitution of the University of London as a teaching University. The Senate and the Convocation—since shorn of some of its privileges—were not unfriendly to the general idea of a teaching University; and the Senate was even prepared to accept college examinations for pass degrees.

It is of interest to note that the College to which the new scheme is to be applied is the College with which Huxley was connected as dean and professor, and that the policy adopted harmonises with his general views. Huxley had a fine conception of the University which London ought to possess. In his evidence given before the Gresham Commission in 1892- a model for soundness of judgment and clearness of expression- he severely condemned the attempt of University College and King's College to "corner" university education in London. As an alternative to the creation of a separate teaching university, he urged that the title and prestige of the University of London should be retained, and the University reorganised in such a manner as to secure uniformity and efficiency in all university work, with freedom and elasticity. "In short, unify without fettering." As to the conduct of university examinations, he urged the Commission to leave the question quite open. Degree-giving was a subsidiary matter, not an end in itself. While Huxley was in favour of trusting a college to organise and test the training of its students, he considered that some outside control was desirable, because every man has a "list," as they say at sea.

The working of this experiment in relating college teaching to university examinations will be watched with interest, and its success may produce important results throughout the Empire in the direction of greater variety and elasticity in all our educational arrangements. Let us hope, too, that it may tend to reduce the fervour of some of the worshippers of the examination-fetish. The internal results should be not less valuable. The Imperial College has not only closed a barren controversy, but also in the process has been selected for a position of special privilege in the University. *Noblesse oblige.* The University, faced with many other difficult problems, is entitled to the full co-operation of all its affiliated colleges. Only last week the partial failure of the Bloomsbury site scheme was announced by the publication of some uninspired correspondence between the Treasury and the Principal Officer of the University. This partial failure is due to the Government's arranging for the transfer of King's College to Bloomsbury without taking the elementary precaution of ascertaining whether this great College wished to move. The problem of providing a home worthy of the University of the metropolis of the Empire still remains. T. Ll. H.

Crop-Production in India.

Crop-Production in India: a Critical Survey of its Problems. By A. Howard. Pp. 200. (London: Oxford University Press, 1924.) 10*s.* 6*d.* net.

IN recent years some of the lustre of what Disraeli in a flamboyant phrase described as "the brightest jewel of the British crown" has been dimmed by political happenings. In the less spectacular sphere of economic improvement it might be said that new facets continue to be added to the jewel. The most rabid of Swaraj fanatics must acknowledge that, if British rule has accomplished nothing else, it has, at least, given their country material benefits in fullest measure. Of these no better example can be found than the achievements of the small band of scientific workers who, during the last twenty years, have been applying scientific methods to Indian agriculture.

The most distinguished of these pioneers sets out the amazing story in the volume before us, and it is one calculated to excite the envy of his scientific colleagues all over the world. He presents a record, not only of scientific achievement, but also of an organisation under which the public support of science is not limited to the grudging provision of doles in aid of scientific research; for in India we see in operation a system of government under which the supreme power, when satisfied that scientific work has been successful, straightway by administrative and legislative measures sets a seal on that work. One example will suffice. Mr. Howard and his colleagues establish that an improved cotton (that is, a plant yielding a better fibre and more of it) cannot be effectively introduced unless steps are taken to prevent cross-fertilisation with inferior varieties; thereupon an Act is passed by the Legislature sanctioning the prohibition of the sowing (say in a district of 2000 square miles) of any variety of cotton other than that prescribed by expert plant breeders. But it must not be thought that peaceful penetration is not practised also. The poor *rayat* of India (whose life has been aptly described as "a long-drawn question between a crop and a crop") is as fully alive to the value of good seed as his fox-hunting cousin in the shires; witness such figures as these. The area under Pusa 4 and Pusa 12 (two of Mr. Howard's new wheats) in the United Provinces is now 500,000 acres, and in the North-West Frontier Province 200,000 acres. In the Panjab colonies a new wheat known as Panjab 11 now occupies upwards of 750,000 acres. The achievements of the workers on cotton improvement are equally striking. In the Central Provinces the area under a new variety of this crop, introduced by the Agricultural Department, amounts to 700,000 acres, giving an additional profit to the cultivator of 20*s.* per acre.

In the case of rice (which in India occupies upwards of 80 million acres) some of the figures are equally astonishing, and the catalogue might be extended; many of the crops grown for fibre (such as jute) and for oil (such as linseed) have also yielded results to the scientific plant breeder.

The chief aim, however, of Mr. Howard's book is not to record economic results, many of which flowed from the application of scientific method rather than from original research. During the course of the work a number of problems requiring solution have been brought to light, and Mr. Howard has endeavoured to "set out these problems in simple language" with the view of securing the active co-operation of the public. (In other words, the days of paternal government are passing and the burden which is laid upon scientific workers in democratically governed countries is fast descending upon India.) The problems presented do not affect India alone. They affect the whole field of current knowledge regarding the soil and the plant. Workers in the sciences related to agriculture in all countries will find much food for thought in these pages.

The men who—as a result of Lord Curzon's enlightened policy—went out to India in 1904, found that their text-book knowledge was of little help; nor was Voelckers' classic report (*circa* 1890) of much assistance; for at that date the rôle of the leguminous plant in enriching the soil was unknown. Incidentally, it was familiar to the Indian *rayat*. The writer well remembers extracting, about that period, from a brown man in a loin-cloth a list of crops that enriched his soil—a catalogue, it proved, of some ten varieties of leguminous plants, ranging from the shrub-like Cajanus to the weed-like Lathyrus.

Fortunately, this early period almost coincided with the birth of the Cambridge school of genetics, which, under the inspiration of Bateson and his disciples, has done so much to promote the economic welfare of agriculture. No better field than India for the exploitation of such master ideas as those of the "unit character" and "pure line" could have been found, and of these two tools (in contradistinction to what was experienced in more advanced countries) the latter—the pure line conception—has proved the more useful. As Howard, however, so aptly points out, economic plants fall into two very distinct categories from the point of view of the practical outcome of scientific plant breeding. The isolation and economic introduction of pure lines of plants which are normally self-fertilised—such as practically all the cereals—offers no difficulty; the production of a sufficiently diverse F_2 is the only problem. In the case of normally cross-fertilised plants, however, such as cotton (or the Brassicæ), the practical obstacles are serious. As indicated above, this problem has been partly solved in India by drastic legislation of a type to which the free-born Western would probably never submit. If to free cross-fertilisation self-sterility be added (the clover is an example), the problem of seed production, both scientifically and practically, becomes one of extreme difficulty. As our author points out, "the creation of an improved variety of crop, by itself, is of no practical advantage to the country: it possesses only a potential value. The new variety must be welded into the rural economy before a real economic result can be achieved." It is perhaps one of the most striking features of the Indian achievements that the plant breeders there have studied intensively and successfully this problem of adapting their improvements to rural economics.

To return to the agricultural problems which confront the scientific workers in India: of these the most puzzling, perhaps, is provided by rice, an aquatic plant with no obvious access to added nitrogen. The produce of 10 million acres of this crop has been exported from Burma annually for the last twenty years, and yet the soil shows no signs of diminishing fertility. The problematic source of nitrogen may be fixation by the algæ which inhabit the swamps in which rice is grown. Then, as to the source of the oxygen needed by the roots of the plant, we seem to be equally in the dark. Other problems which have arisen may be briefly indicated. The relation between the economic behaviour of crops and their root development is still obscure. Many facts can be instanced to show that a close relation exists between the quality of a crop and the root development of the plant in varying soils; and an equally important connexion appears to exist between root development and susceptibility to disease. The author believes that attacks of disease in economic plants simply indicate faulty cultural methods, a view that seems to find a parallel in some modern ideas as to disease in the human subject. He is identified with extreme views on the importance of soil aeration, but there can be no question that he presents a body of facts which strongly supports his theories on the subject. The whole question of the "gearing" (as he terms it) between the plant and the soil stands in need of thorough investigation in the light of newer knowledge.

The work of Howard, and, may we add, of his equally distinguished wife, may be taken as a model of what is required of research workers in the applied sciences—the practice of pure scientific research coupled with the rare faculty of a steadfast outlook towards the ultimate economic application of the results. These are qualities which should prove of great value in the direction of the all-India cotton research station to which the author has recently been appointed. A. B. B.

The Literature of Chemical Technology.

Synthetic Organic Compounds. By Dr. S. P. Schotz. Pp. 412. (London: Ernest Benn, Ltd., 1925.) 45*s.* net.

SEVERAL books have appeared during the past year or so, both in Great Britain and in the United States, which deal with certain special branches of chemistry from the industrial and manufacturing points of view. Without doubt many of these treatises are excellent and constitute well-written and concise accounts of particular types of manufacture. They may be regarded, therefore, as valuable contributions to technological literature, and are comparable in this respect with similar treatises written by experts in one or other of the many sections of scientific chemistry. In each case the author may be supposed to have, not only a far-reaching knowledge of his subject, but also to possess sufficient wisdom, as distinct from knowledge, to enable him to sift the grain from the chaff in the published literature of the subject with which he deals. Nevertheless, even in a clear-cut comparison such as this, the difficulties met with by the two types of author are very different.

The writer of the scientific treatise finds to hand a vast amount of published detail from which to draw his material. Moreover, he can assume, with a reasonable amount of confidence, that the sources on which he relies constitute accurate and truthful records of the experimental work done and the conclusions reached. The fact that they have been issued under the auspices of one or other of the world's scientific societies gives him the right to assume that they have been published without reserve or ulterior motive.

On the other hand, the writer of the technological book, as soon as he passes away from matters of personal knowledge, finds himself beset by many troubles which will require the greatest powers of discrimination to overcome. For example, he will have to draw largely on the patent literature; and chemical patent literature, especially that of certain foreign countries, is in some instances a compilation of experimental data, and conclusions deduced therefrom, often emanating from the imaginations of those patentees who wish to retain some special field for the exercise of their own activities, or who may wish to mislead their competitors. He will also have to use the chemical technological literature published in one or other of the various journals devoted to this subject, and, here again, he will encounter difficulties. This type of literature is on the increase, and already there are many publications catering for the requirements of the works chemist and chemical engineer. In them the letterpress and the illustrations often serve as convenient vehicles for the advertisements which form the major portions of the periodicals. The illustrations and the advertisements are mostly those of plant, and this is a useful feature for those who wish to keep themselves in touch with the development of engineering chemistry. The letterpress is, however, frequently of the chatty and personal kind, and only a portion of it is devoted to articles and papers on manufacturing processes and reactions. But, in the very nature of things, it is obvious that such contributions can only be written by authors from the outside, because it is unthinkable that any sane manufacturer, or employee of a manufacturer, would be prepared to publish details of plant and processes very rightly regarded as essential to his works practice and prosperity.

Finally, there are the secret matters, researches carried out by the governments of States in the national interest, usually for war purposes both offensive and defensive. It is here that the angels fear to tread and where discrimination will counsel avoidance. The difficulties in these cases embrace both the types mentioned above, since publication implies either that the data is useless or out-of-date, or that the information is supplied with the direct object of creating a false impression and of misleading a possible enemy. It is evident that no State, however altruistic in outward appearance, would allow any matter of real importance in relation to its war activities to be published, and any chemist doing such a thing from sure knowledge would, in Great Britain, soon fall foul of the Official Secrets Act.

It is therefore clear that the way of the author of the technological book is, indeed, hard, even when he confines himself to some particular branch of his subject with which he has special acquaintance. What then is to be said of a book, such as that under review, which purports to cover the wide field of synthetic organic chemistry, a field with which no human being could possibly have intimate personal knowledge even on the scientific side alone?

It is not suggested that the author has not attempted to carry out his Herculean task with courage and ability. The book has entailed the exercise of great industry and skill in its compilation, and it is evident that the author possesses a wide knowledge of the many intricate subjects with which he deals. It is readable, and the printing and paper leave nothing to be desired. It contains a great deal of information which will be useful to the general reader, although some of the statements made may anger the expert. One general criticism that could be raised is that the formulæ are too elaborate and the frequent use of the benzene ring wholly unnecessary. It is, for example, a shocking waste of the excellent paper to print the formulæ of the phenol-formaldehyde resins on pp. 384, 386, and 387. These formulæ are not based on any single shred

of scientific evidence, and are, indeed, in the highest degree unlikely. The illustrations of plant are admirable, and will serve as excellent advertisements for the firms supplying them. Indeed, it is evident that they are intended as such, because the "Bakeliser" (Fig. 109, p. 372) is also reproduced in the advertisement pages at the end of the book, and when this is not the case, the name of the firm supplying the apparatus appears under the illustration. The plants of the various processes described are also reproduced clearly.

The reviewer has, therefore, no quarrel with the author, but, on the contrary, congratulates him on having accomplished a very difficult task with commendable ability. It is rather the object and utility of the book that he calls in question. As a scientific treatise it is of little value, and as a technological handbook it is in many respects misleading. The statements made, for example, in the article on chemical warfare will bring a smile to the lips of those who have inside knowledge of this subject.

With what, then, are we dealing, and to what kind of reader is the book likely to appeal? It is, as already stated, readable, and will doubtless interest a number of people who take their chemistry lightly and superficially; but, if this were intended, it is surely unnecessary to have included the complex descriptions of intricate organic reactions which only the expert can follow. It may be intended to appeal to manufacturers and to chemists engaged in industrial work, and here again material will be found which will be of interest and general utility, although, if the chemist happens to meet a description of any method of which he has special knowledge, he is not likely to place much reliance on the accounts of other processes. In effect, therefore, the book will appeal to a number of various types of people who may wish to acquire a superficial and incomplete knowledge of many of the operations now carried out in modern organic chemical manufacture and are not in a position to be hypercritical of the information they receive. Doubtless there are several of these, since this is only one of the many books of its kind which have been published and, we understand, are about to be published, and it is only reasonable to suppose that their production pays.

Moreover, there can be no question that books of this kind serve a useful purpose in popularising science, and in bringing home to many people the achievements which the modern development of scientific industrial methods have accomplished in supplying them with some of the present-day requirements of life. The only doubt in the present instance is whether the author has supplied sufficient jam to mask his very large pill and to make it palatable to the general reader.

J. F. T.

The Electrical Theory of Matter.

Handbuch der Radiologie. Herausgegeben von Prof. Dr. Erich Marx. Band 6: Die Theorien der Radiologie. Bearbeitet von M. Laue, P. Zeeman, H. A. Lorentz, A. Sommerfeld und G. Wentzel, Georg Joos, E. Riecke, L. Vegard, P. Debye. Pp. xi+806. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1925.) 40 gold marks.

THERE exists scarcely any branch of science which is not indebted to Germany, not only for important original contributions to its progress, but also for the publication of excellent and comprehensive treatises. With the appearance of this sixth volume, another of these so-called handbooks reaches completion. It is now some years since the last of the previous volumes was published, and it is evident, from the remarks made by the general editor, Dr. Marx, that this volume has only reached completion after much delay and the surmounting of many difficulties. That this should be so is scarcely surprising. From the theoretical point of view, modern physics is in a peculiar position. The two rival theories—the older classical theory and the more modern quantum hypothesis—have each met with marked success in interpreting observed results, but we are still very much in the dark as to the real connexion between the two. Where one fails the other as often as not succeeds. We must therefore be prepared, in such a volume as this, to find, not so much a logical development, but rather a series of attempts at correlating observed phenomena in terms of one or other of the two main lines of thought; and this indeed we actually find.

To do justice in small space to a volume of this magnitude, dealing with mathematical theory and coming from the pens of seven separate authors, is clearly impossible. Fortunately, with such names as Lorentz, Laue, Sommerfeld, Debye, and others on the title-page, there is little room for doubt as to the quality of the contents. From such authors we know what to expect, and a closer inspection does not disappoint us. The previous volumes dealt essentially with the more experimental side of modern physics, and it was intended to devote the final volume to a discussion of its purely theoretical aspect. While this plan has been to a large extent adhered to, the reader will find a pleasant variation in the few chapters which deal with experimental results in fields which have not been covered in the previous volumes. Notable in this connexion are the excellent account of the Zeeman effect and Dr. Joos's summary of the results of work on ionisation potentials.

The volume opens with a discussion of the motion of a free electron in various types of electric and magnetic

fields; after a very full treatment of this question, Prof. von Laue proceeds to consider the problems of conduction through gases and the passage of α and β particles through matter. The discussion of the motion of the free electron is naturally followed by an account of the motions of electrons in the atomic field and of the way in which these may be influenced by external forces. A most lucid description of the magnetic separation of spectral lines comes, as is only fitting, from Prof. Zeeman, whose name the phenomenon bears. That the theory of the effect should be contributed by Prof. Lorentz is also most appropriate, since it was he who first put forward a quantitative explanation of the influence of a magnetic field on the spectrum. The abandonment of the original theory based on the classical mechanics in favour of one founded on the quantum hypothesis is an example of what has taken place in many branches of physics. A general account of the origin of optical spectra on the basis of the Bohr atom is developed by Prof. Sommerfeld and Dr. Wentzel. Prof. Sommerfeld's work on this subject is so well known and so widely appreciated that there is no need to dwell on the merits of this section. The summary by Dr. Joos, dealing with ionisation potentials and the conditions for the excitation of spectra, forms a suitable conclusion to the treatment of atomic radiation.

A long and detailed account of the electrical theory of the solid state, dealing notably with such problems as electric and thermal conductivity, was contributed by the late Prof. Riecke. As a considerable period has elapsed since this section was written, it has been copiously annotated by Prof. Laue in order to bring what is a very thorough discussion up-to-date.

One of the most readable sections is that on the aurora by Prof. Vegard. It is a subject that the author has made peculiarly his own, and his description of the observed facts and the theory are full of points of interest. Some of his conclusions have recently been questioned, especially his explanation of the source of the famous green line; but whether or not his theory will require modification, it has already achieved one of the main objects of any theory in suggesting a new field of research in the study of the spectra emitted by matter at extremely low temperatures when bombarded by electrons.

The final chapters, written by Prof. Debye, are devoted to the theory of the electrical and magnetic properties of molecules. The subject is one of great complexity, and it is impossible not to admire the way in which it has been treated. The subject of magnetism has perhaps scarcely kept pace with the progress which has been made of recent years in other branches of physics, but signs are not wanting that the near future will see a rapid development. Prof. Debye's account, written in his extremely lucid style, indicates some of the lines along which we may expect progress.

The editor and his collaborators are to be congratulated on the completion of the "Handbook of Radiology." This final volume will prove invaluable to all students of modern physical theory, inasmuch as it gives full discussions, with extensive references to original papers, of a wide range of subjects, many of which have not so far received adequate treatment in text-book form. The book is full of indications of probable lines of advance, and in this respect will make an appeal not only to the theorist but also to the experimental worker.

Digitalis in Medicine.

The Action and Uses in Medicine of Digitalis and its Allies. By Prof. Arthur R. Cushny. Pp. xi+303. (London: Longmans, Green and Co., 1925.) 18s. net.

OUR knowledge of the action of digitalis on the heart was founded by William Withering, of Birmingham, whose classical treatise was published in 1785. Since that time, owing to the multiplicity and scope of the researches of an ever-increasing number of workers, the literature of the subject has reached such proportions that an attempt to collect together and analyse the results achieved appears already overdue. Prof. Cushny has undertaken this arduous task in compiling the monograph under notice, in which the knowledge acquired during thirty years of personal research is embodied in a critical account of the whole subject, from the time when digitalis was first employed in heart disease up to the present day.

The book opens with an account of the various drugs of the digitalis group and their histories. It is not certain when digitalis first came into medical use, but it was known long before Withering's time, and the English term "foxglove" may bear some allusion to Fuchsius of Tübingen, who described it in 1542 as an emmenagogue. Apart from digitalis, many of these drugs were originally employed as arrow poisons, and for the purpose of trial by ordeal, by the natives of Africa and the Malayan Archipelago. A detailed account is given of the action of digitalis on the frog's heart, illustrated by numerous graphic records of the heart movements. The reaction of the mammalian heart to digitalis, as seen in animal experiment, is similarly dealt with. Some conception of the scope of the laboratory investigation is gained when we are told that the effect of digitalis or allied drugs on the heart is known in the cases of the frog, toad, grass snake, green lizard, rat, tortoise, crab, crayfish, lobster, snail, newt, tadpole and embryonic chick, among others.

Pigeons are relatively susceptible to the drug, rats and toads tolerant, while man is more susceptible, weight for weight, than animals.

In Chapter vi. the author discusses at length the action of digitalis on the blood pressure. Blake's discovery in 1839 that a rise in arterial tension was produced in animals by large doses of digitalis gave rise to a controversy over its action in man which has persisted almost up to the present day, although Sahli showed in 1901 that this result did not follow therapeutic doses. Prof. Cushny holds it proved that this rise in blood pressure seen in animals is due mainly to constriction of the vessels, but he emphasises the fact that there is no evidence of a similar effect being brought about in man by medicinal doses of the drug. No doctrine has died harder among medical men than the belief that digitalis is dangerous in cases of high blood pressure, but it is to be hoped that this has now been finally banished from medical teaching.

After a description of the effects of digitalis on organs other than the heart, its absorption, elimination, and cumulative action, seventy pages are devoted to therapeutics. Withering's knowledge of digitalis was the outcome of ten years' clinical observation in his practice, and although his work was followed by such a vast amount of research in animals, no real advance in the clinical use of the drug can be said to have occurred until more than a century later, when Sir James Mackenzie discovered its almost specific action in cases of auricular fibrillation, again as the result of clinical observation. In the case of abnormal heart rhythms the mechanism of the action of digitalis is now well understood, but we are still unable to account for its variable and uncertain effect in cases of normal rhythm. On this obscurity Prof. Cushny is unable to throw any new light, but we gather that he regards the direct action on the heart muscle, increasing the force of the contraction, as a more important factor than the reduction in rate in bringing about the undoubted clinical improvement which sometimes follows digitalis administration in these cases. At present this cannot be accepted as proved, and it is here that future researches may be expected to add to our knowledge. In pneumonia the author believes that digitalis can effect the heart beneficially, but he is unable to arrive at any definite indications for giving the drug, and does not advise its routine use in this disease.

The effect of digitalis on the electro-cardiogram is described, and we are somewhat surprised to find that Prof. Cushny attaches so little significance to the flattening and inversion of the T-wave which is such a constant effect of adequate doses of the drug in practice. The book concludes with a description of the various preparations of digitalis and the methods used in their assay. A bibliography of 559 references to the literature is placed at the end of the book.

A treatise of this nature, covering the ground of both laboratory research and clinical practice, and coming from such an authority as Prof. Cushny, who has himself played no small part in the development of the subject, is an invaluable addition to the literature of digitalis. Moreover, the book affords the reader ample opportunity for studying the relationship of animal experiment to practical medicine. The fact that the reaction of healthy animals to poisonous doses of a drug may differ widely from the effects of medicinal doses on diseased mankind has not always been sufficiently appreciated in the past, mainly perhaps owing to the tendency of the laboratory worker to become too isolated from the clinician. The advantages of close co-operation between laboratory and clinic are nowhere better illustrated than in this admirable account of the work which has transformed digitalis, once an old country remedy for dropsy, into what may be justly described as one of the best-mapped regions of therapeutics.

Our Bookshelf.

Monographs of the Geological Department of the Hunterian Museum, Glasgow University. 1. *The Collection of Fossils and Rocks from Somaliland.* Made by B. K. N. Wyllie and Dr. W. R. Smellie. Pp. vi + 180 + 18 plates. (Glasgow: Jackson, Wylie and Co., 1925.) 42*s.* net.

THIS work deals mainly with the palæontology of the Jurassic, Eocene, and Oligocene deposits of part of the maritime plain of British Somaliland in the neighbourhood of Bulhar and Berbera (Gulf of Aden), and is based on the collections made by Messrs. Wyllie and Smellie when surveying the region on behalf of the Anglo-Persian Oil Company. It is to be hoped that other companies will adopt this policy of allowing matter of geological interest to be published. The collection has been presented to the Glasgow University Museum.

A summary of the geology of the district is given by B. K. N. Wyllie, based on the joint work of himself and Dr. Smellie, but petroleum is not mentioned. The palæontology is the work of R. B. Newton (Foraminifera and Nautilus), J. W. Gregory (Corals), E. D. Currie (Echinoidea), J. Weir (Brachiopoda and Mollusca), and L. F. Spath (Ammonites). A short account of the igneous rocks is given by A. T. Neilson.

The Jurassic deposits consist of (1) a lower series, the Bihin Limestone, 1000 feet thick, of which the age is not precisely determined but appears to range from Bathonian to Oxfordian. The corals and echinoids are unlike those of Cutch but have affinities with European faunas of similar age, from which it is inferred that the Somaliland sea had no direct connexion with that of western India but must have been a gulf from the Mediterranean. (2) The upper series, known as the Meragalleh limestone, 2300 feet in thickness, is shown

by the ammonites to be mainly Kimeridgian but possibly extending into Tithonian and Infravalanginian. The differences between the ammonite faunas of Somaliland and other regions are regarded by Spath as due to differences of age rather than to difference of facies or geographical province.

The beds of Eocene age consist of limestones and sandstones containing corals, echinoids, lamellibranchs, Nautilus, etc. At about the middle some 2000 feet of gypsum and anhydrite occur, indicating that part of the sea became isolated and underwent intense evaporation. The Oligocene limestone is regarded as of Aquitanian age and contains calcareous algæ, forminifera, corals, etc. The corals resemble those of the Tongrian of northern Italy, Austria, and the West Indies. The absence of Miocene and Pliocene deposits suggests that the Gulf of Aden was not covered by sea until the end of Pliocene times, a little earlier than the date of the raised coral reefs.

It is unfortunate that in many cases the figures of the fossils are unsatisfactory. Some of the specimens were evidently unsuitable for illustration by photographic means and their characteristics cannot be made out.

Researches on Fungi. By Dr. A. H. Reginald Buller. Vol. 3: The Production and Liberation of Spores in Hymenomycetes and Uredineæ. Pp. xii+611. (London: Longmans, Green and Co., 1924.) 30*s.* net.

IT is a pleasure to welcome the third volume of Dr. Buller's researches into the production and liberation of spores in the fungi, the second volume of which was noticed in NATURE of October 27, 1923, p. 614. The delicacy of technique, the minuteness and exactness of the observations, and the assiduousness in the elucidation of abstruse details so characteristic of the first two volumes are well maintained in the present work.

In Part I. the author continues his observations on the mechanisms of spore dispersal in the Agaricineæ. He distinguishes two main types of organisation for the production and liberation of spores: (1) Æquihymeniferæ, with thick wedge-shaped gills, not afterwards destroyed by autodigestion, and (2) Inæquihymeniferæ, with thin parallel-sided gills, afterwards autodigested from below upwards. In the first five chapters the fruit mechanisms of sub-types of the first group are described, *e.g.* Lepiota, Bolbitius, Armillaria. Most of the remainder of Part I. deals with sub-types of the second group, as exemplified by species of Coprinus. Some interesting material on the bilumenescence of Panus, and the parasitism of Agarics on Agaric hosts, is also introduced. Part II. of the volume takes up the production and liberation of basidiospores in the Uredineæ. Dr. Buller finds the essentials of spore dispersal similar to those of the Hymenomycetes. In this case, however, the spores are larger and are shot to a greater distance. Some teleological but none the less interesting correlations are given regarding the curvature of the basidium in Uredineæ, and the straight form found in most Hymenomycetes. As in the first two volumes, the book is profusely illustrated with interesting photographs and many of the author's fine drawings. J. E.

Offa's Dyke. By J. H. Hewlett. Pp. 32+8 plates. (London: Simpkin, Marshall and Co., Ltd., n.d.) 3*s.* 6*d.* net.

FOR some time past it has been evident that public interest in archæological discovery has been on the increase, and that this interest has extended to sites of historic and prehistoric importance is to some extent borne out by the protests aroused some two years ago by the threat to interfere with the amenities of Stonehenge. Mr. Hewlett's description of Offa's Dyke is a book which is welcome on this account. The more well-informed the public is about the antiquities of the countryside, the better chance of the avoidance of wanton damage. Mr. Hewlett has divided his account of this interesting defensive work into five sections. In the first, he gives a general description of the dyke; in the second, he traces its course and offers suggestions as to its line where it has now disappeared; in the third, he describes the country through which it passes; in part four he discusses the theories of its purpose; and in the fifth, gives the main facts connected with the life of Ossa. As to its original place of termination in Flintshire, which is still a problem, Mr. Hewlett states the theories which have been put forward, but himself has no solution to offer, although he is of the opinion that it is Wat's Dyke and not Offa's Dyke which ends at Basingwirke, notwithstanding the occurrence along this line of place-names such as Plas Offa, Bryn Offa, and Clawdd Offa (Offa Dyke).

Handbuch der Pflanzenanatomie. Herausgegeben von Prof. K. Linsbauer. Abteilung 2, Teil 2: Bryophyten. Band VII/1: Anatomie der Lebermoose. Von Prof. Dr. Th. Herzog. Pp. iv+112. (Berlin: Gebrüder Borntraeger, 1925.) 8·70 gold marks.

DR. TH. HERZOG has produced a monograph of 108 pages with ninety-three text figures upon the anatomy of the liverworts, and in this space it would appear possible to give a very complete report of progress in this very specialised field. There is, however, no mention of mycorhiza, and some important American work is not discussed. The work is divided into three sections. In the first there is a description of the various types of differentiated cell reported in the group, and it is striking how frequently these differentiated elements are to be found in thalloid forms. This section is followed by two further sections, dealing with the anatomy of gametophyte and sporophyte respectively, in which each group of the liverworts is passed in review in turn.

Introduction to Modern Political Theory. By C. E. M. Joad. (The World's Manuals.) Pp. 127. (Oxford: Clarendon Press; London: Oxford University Press, 1924.) 2*s.* 6*d.* net.

THIS short manual gives an excellent and clear account of the various socialistic and communistic theories which have recently become important owing to the success of the revolutionary movement in Russia. Mr. Joad takes naturally to this kind of work and is peculiarly well fitted for it. He can write sympathetically without the loss of balance which spoils the work of the propagandist.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Taungs Skull.

THE account which Prof. Dart published of the Taungs skull (NATURE, Feb. 7, p. 195) left many of us in doubt as to the true status of the animal of which it had formed part, and we preferred, before coming to a decision, to await an examination of the fossil remains, or failing such an opportunity, to study exact casts of them. For some reason, which has not been made clear, students of fossil man have not been given an opportunity of purchasing these casts; if they wish to study them they must visit Wembley and peer at them in a glass case which has been given a place in the South African pavilion.

The chief point which awaited decision relates to the position which must be assigned in the animal kingdom to this newly discovered form of primate. Prof. Dart, in writing of it, has used the name of anthropoid ape; he has described it as representing "an extinct race of apes intermediate between living anthropoids and man"—which is tantamount to saying that at Taungs there has been discovered the form of being usually spoken of as the "missing link." That this is his real decision is evident from the fact that he speaks of it as "ultrasimian and prehuman" and proposes the creation of a new family for its reception.

An examination of the casts exhibited at Wembley will satisfy zoologists that this claim is preposterous. The skull is that of a young anthropoid ape—one which was in the fourth year of growth—a child—and showing so many points of affinity with the two living African anthropoids—the gorilla and chimpanzee—that there cannot be a moment's hesitation in placing the fossil form in this living group. At the most it represents a genus in the Gorilla-Chimpanzee group. It is true that it shows in the development of its jaws and face a refinement which is not met with in young gorillas and chimpanzees at a corresponding age. In these respects it does show human-like traits. It is true that it is markedly narrow-headed while the other African anthropoids are broad-headed—but we find the same kind of difference in human beings of closely allied races. Prof. Dart claimed that the brain showed certain definite human traits. This depends upon whether or not he had correctly identified the position of a certain fissure of the brain—the parallel fissure. In the show-case at Wembley a drawing is placed side by side with the "brain cast"; but when we examine the brain cast at the site where the fissure is shown on the drawing, we find only a broken surface where identification becomes a matter of guess-work.

In every essential respect the Taungs skull is that of a young anthropoid ape, possessing a brain which, in point of size, is actually smaller than that of a gorilla of a corresponding age. Only in the lesser development of teeth, jaws, and bony structures connected with mastication can it claim a greater degree of humanity than the gorilla. Its first permanent molar teeth which have just cut are only slightly smaller than those of the gorilla, while the preparations which are being made in the face for the upper permanent canines show that these teeth were to be of the large anthropoid kind.

The other point on which we awaited information related to the geological age of the Taungs skull. Fortunately, Dr. Robert Broom (NATURE, April 18, p. 569) has thrown a welcome light on this matter. The skull was blasted out of a cave which had become filled up by sand washed in from the Kalahari. The fossil baboons found in neighbouring caves differ in only minor structural details from baboons still living in South Africa. In Dr. Broom's opinion the Taungs skull is of recent geological date; it is not older than the Pleistocene; he thinks it probable that it may not be older than the fossil human skull found in a limestone cave at Broken Hills, Rhodesia. It is quite possible—nay, even probable—that the Taungs anthropoid and Rhodesian man were contemporaries. Students of man's evolution have sufficient evidence to justify them in supposing that the phylum of man had separated from that of anthropoid apes early in the Miocene period. The Taungs ape is much too late in the scale of time to have any place in man's ancestry.

In a large diagram, placed in the show-case at Wembley, Prof. Dart gives his final conception of the place occupied by the Taungs ape in the scale of man's evolution. He makes it the foundation stone of the human family tree. From the "African Ape Ancestors, typified by the Taungs Infant," Pithecanthropus, Piltdown man, Rhodesian man, and African races radiate off. A genealogist would make an identical mistake were he to claim a modern Sussex peasant as the ancestor of William the Conqueror.

In the show-case at Wembley plastic reconstructions are exhibited in order that visitors may form some conception of what the young Taungs Ape looked like in life. Although the skull is anthropoid it has been marked by a "make-up" into which there have been incorporated many human characters. It is true the ears are those of the chimpanzee, but the forehead is smooth and rounded, the hair of the scalp is sleek and parted; the bushy eyebrows are those of a man at fifty-five or sixty; the neck is fat, thick, and full — extending from chin to occiput. In modelling the nose, gorilla lines have been followed, whereas the nasal part of the skull imitates closely chimpanzee characters. The mouth is wide, with a smile at each corner.

Prof. Dart has made a discovery of great importance, and the last thing I want to do is to detract from it. He has shown that anthropoid apes had extended, during the Pleistocene period, right into South Africa—into a land where anthropoid apes could not gain a livelihood to-day. He has found an extinct relative of the chimpanzee and gorilla but one with more man-like features than are possessed by either of these. His discovery throws light on the history of anthropoid apes but not on that of man. Java-man (Pithecanthropus) still remains the only known link between man and ape, and this extinct type lies on the human side of the gap.

ARTHUR KEITH.

June 22.

Spectroscopic Evidence of *J*-Transformation of X-rays.

IN a recent letter to NATURE (April 25) Messrs. Khastgir and Watson have given some graphical tables where the wave-lengths of the X-ray line *K* are plotted against the atomic number of the elements Nos. 48-60. In these curves there are two discontinuities at *Z* 52 and at *Z* 56, which the authors ascribe to the supposed *J*-transformation of Barkla. The authors state as follows (p. 605): "This seems to be the first spectroscopic evidence of the *J*-transformation."

The curves are said to represent the results of my measurements of the K wave-lengths. Several of the values, however, are *not* those found in my laboratory, but seem to be taken from different, and not very concordant, measurements. For example, the element Cs (55) had never been published in any paper from my laboratory at the time when the letter by Messrs. Khastgir and Watson was written.

The K-series of the elements in question had been measured in my laboratory once by Dr. Malmer in the earliest days of X-ray spectroscopy (1914–15). His measurements give no evidence of such a sudden change in the slope of the curve as shown in the letter of Messrs. Khastgir and Watson. As these values were obtained with a simple, and not very accurate, method, there are accidental errors of the magnitude 0·005 Å.U. In the *Phil. Mag.* for

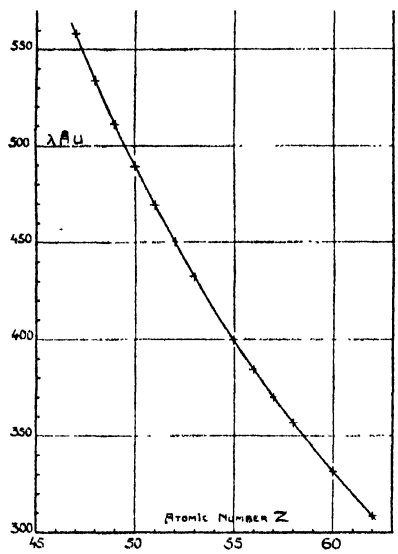

FIG. 1.

November 1919, Dr. Leide and the author described a new method and an instrument by which more accurate measurements could be obtained in this region of wave-lengths. Dr. Leide, who has been working with this apparatus, has just published the results in his dissertation (Lund: Gleerup; and some previous results of his investigation were given in my book, "X-ray Spectroscopy"). His values, which ought to be about 100 times as accurate as those mentioned above, are as follows:

Z.	$K\alpha_1$ λ Å.U.	Z.	$K\alpha_1$ λ Å.U.
47	0·55821	55	0·39959
48	·53386	56	·38445
49	·51103	57	·37004
50	·48948	58	·35647
51	·46931	59	..
52	·45037	60	·33125
53	·43249	61	..
54	..	62	·30833

In the diagram the wave-lengths are plotted against the atomic number Z.

No trace of such discontinuities as described by Messrs. Khastgir and Watson is to be seen.

MANNE SIEGBAHN.
Physical Laboratory, University, Upsala,
May 30.

IN a recent number of NATURE (April 25, pp. 604-605) there is a letter by Khastgir and Watson describing what is apparently spectroscopic evidence of J-transformation of X-rays. It is the purpose of this note to direct attention to data of more recent date which would indicate that these so-called evidences are caused by experimental inaccuracies in determining the wave-lengths of X-ray emission spectra.

It appears from the graph of Khastgir and Watson

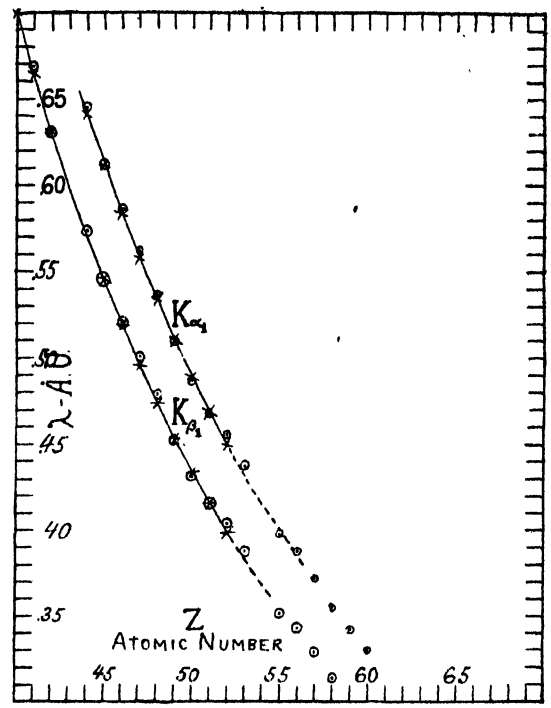

FIG. 1.

that they used values of λ which were determined by Malmer in 1915 (tabulated in "Atomic Structure" by Sommerfeld, p. 153). Siegbahn ("Spektroskopie der Rontgenstrahlen," 1924, pp. 101-102), however, gives values of λ which in some cases are quite different from those of Malmer. I have plotted the values of λ according to Siegbahn's latest work against the atomic number and find that the points fall on a smooth curve, and that there are absolutely no discontinuities. These points are indicated by crosses in the accompanying diagram (Fig. 1). The dots with circles around them indicate the values due to Malmer. Both the $K\alpha$ and $K\beta$ lines are shown in the plot.

It would seem, therefore, that Khastgir and Watson have been led into error by experimental inaccuracies and the peculiar coincidence that the greatest deviation from more recent wave-length determinations occurred at points which correspond with two of the critical absorbabilities for J-transformation. There is, therefore, no spectroscopic evidence of the so-called J-transformation of X-rays.

W. W. NIPPER.
Washington University,
Saint Louis,
Missouri,
May 19.

The Conditions for Calcareous Metabolism in Oysters and other Marine Animals.

THE summer of 1924 was remarkable for an unusually large and heavy growth of the shell of native oysters on most beds in England. In a recent survey of the Fal Estuary oyster beds, full details of which it is hoped will be published later, it was found that a total shoot (*i.e.* maximum increase in height or depth of a shell in a ventral direction) of 30 or more millimetres was quite common. Similar large shoots have been observed in shells from East Coast and other beds in 1924. The fact that the summer of 1924 was not a warm one is a matter of common knowledge and of great interest in connexion with the unusual shell-growth. In warm summers, such as we had in 1921, a big growth of shell is usual, but is then attributed to the generally increased metabolism following upon a high temperature, when biological conditions are otherwise satisfactory; but the rate of shell-growth of the oyster (*i.e.* increase in shell-area, and total increase in shell-weight) under any continuously known conditions is still undetermined. It is, therefore, not possible to state what are the precise conditions which are essential for normal or abnormal shell-growth. These conditions, like those in many other problems relating to the oyster, may not be determined until greater concerted attention can be given to what is admittedly a valuable mollusc. In the meantime it may be worth while to summarise a few observations on the subject.

Most lamellibranchs increase the area of the shell by the repeated addition of small concentric deposits at the edge. The oyster, however, makes a relatively large more or less concentric deposit of thin shell at one operation; this thin deposit, called a shoot, quickly hardens by being thickened.

Good practical oyster-producers say that two of such shoots are frequent in a fair year of growth, and the radius of each such shoot in a 2- to 3-inch oyster may be about 10 mm. This year on the Fal 3 and 4 such shoots, all with practical but not absolute certainty this year's growth, may be found. The variability in the number of shoots laid down from year to year is the main cause of the difficulty or impossibility of estimating the age of young oysters, without very intimate local knowledge of the growth-features. In an average year of growth it would appear that the two usual shoots are laid down in the spring and autumn, that is, on either side of the warm—and also spawning—period. But growth ceases in winter for an undefined period, even on beds such as those off Whitstable (in 1920-21 for example) where abundant food is available. Moreover the present writer has shown that oysters taken from the beds *in winter* and kept under warm conditions, even in practically sterile (Berkefeldt-filtered) water, will grow shell. (See Fish. Invest. 2, VI, 3, pp. 43-44—owing to the demands of economy it was only possible to give the bare observations in that paper.) Further, oysters kept in the laboratory in summer will lay down shell automatically in the practical absence of food (see NATURE, vol. 111, p. 14). These facts point to a controlling factor represented by a minimum temperature, below which shell is not or cannot be laid down, and above which shell-material may be produced automatically.

There is no doubt that lamellibranchs in general at our latitudes resemble the oyster in their physiological reactions with regard to shell-growth, one example of which is shown by the writer for the cockle, in NATURE, vol. 111, p. 147, Fig. 2. If, therefore, calcareous material be only laid down with difficulty at low temperatures, it would be highly instructive to have chemical analyses of those thin-shelled forms which are found in polar and deep-sea waters. Indeed a deposition of calcareous material by living marine organisms, although made so easily in the tropics, appears to be found increasingly difficult as the habitat becomes colder. One is tempted, therefore, to inquire what may be the chemical composition of the vertebræ or any bony parts of polar and deep-sea fishes. There is a fundamental similarity in living animals which warrants such an inquiry.

It may be noted in passing that the secretion of siliceous matter can be effected at very low temperatures by polar and deep-sea organisms, in some of which it is possible that deposition of silica may replace that of calcareous material.

In the good shell-growth of warm and relatively cold wet seasons, in Great Britain the corresponding hydrographical conditions are respectively high estuarine salinities, alkalinities, and temperatures, and low fluctuating salinities with medium temperatures and (probably) alkalinities; in the wetter seasons one would also expect a smaller amount of available food-material. An explanation of growth which meets the facts partially may be given as follows: shell-deposition in a warm summer is rapid, and any arrest of growth which may be due to breeding is masked, while in the wet summer, growth occurs continuously in the medium temperature and low salinity and is only slightly arrested by the generally—but not totally—repressed reproductive phases. Shell-growth may occur in the pre-spawning period of females, *i.e.* in the spring, but requires to be observed more fully in marked individuals in the post-spawning period, in which there is a suspicion of a slowing down of the operation.

The good shell-growth in the summer of 1924 may, therefore, be understood if we assume that repression of the reproductive capacities in the relatively cold summer permitted continuous growth, which was apparently accelerated by the low salinity. The arrest of growth when reproduction is possible in invertebrates is indicated in the diminutive size of the breeding individuals in the summer crops of the sponges, Grantia and Sycon, and the very large size possible in the non-breeding wintering forms of the same genera. There is therefore nothing unreasonable in the explanation of growth so far offered. There is, however, another important type of growth which seems to require a different explanation, namely, that which appears to follow removal of oysters to a fresh habitat. For this type of growth a supposition of a general increase in the well-being of the animal does not seem to be sufficient, nor for the fact that an unusual amount of growth occurred in many stunted forms in the Fal Estuary last summer, except that the low salinities, which can be predicted as a result of the heavy rainfall, would be equivalent to a change of habitat. In this respect it is important to note that in the oyster, and doubtless also in related forms, growth does not necessarily follow a mere accumulation of reserve products, as is shown by the fact that "dumpy" (stunted) oysters, which may constitute 40 or more per cent. of a population, were this year on the Fal mostly very well fished (full of reserve products), while the fast-grown oysters were mostly thin and emaciated as though expended in their efforts in growing. Some biological factor appears to shut down the shell-producing mechanism in certain individuals, while in others automatic response to the environment is clearly very prompt. The problem here denoted once more presents the dual interests of science and economics, the boundaries of which cannot be universally defined.

J. H. ORTON.
Marine Biological Laboratory,
Plymouth, June 5.

The Isotope Effect in the Spectrum of Silicon Nitride.

RESULTS of a quantum theory analysis of the SiN bands and of the vibrational isotope effect in these bands were given in an earlier letter to NATURE (March 22, 1924) and in a paper presented at a meeting of the American Physical Society (cf. *Phys. Rev.* 23, 554, 1924). It is now found that the equations given in the latter for these bands are incorrect. This is due to a wrong assignment of vibrational quantum numbers, corresponding to what may be described as an insidious violation of the combination principle. With the data first used, this violation was not apparent, but new data disclose systematic, although rather small, deviations. A new and, this time, correct assignment of quantum numbers has now been made. The following equation holds for the position of the null-lines of the $Si^{28}N$ bands (n' = vibrational quantum number of the initial, n'' that of the final state of the molecule):

$$\nu = 24234{\cdot}2 + 1016{\cdot}30n' - 17{\cdot}77n'^2 + 0{\cdot}41n'^3 - 0{\cdot}0049n'^4 - 1145{\cdot}00n'' + 6{\cdot}570n''^2.$$

The null-lines, it should be stated, can for many of the bands be measured directly on the plates. At the low temperature of the active nitrogen used in generating the bands, the null-line appears as a conspicuous hole in the band structure, on the low-frequency side of the head.

With the new numbering, the various apparent abnormalities previously noted disappear, and an analogy of the SiN bands to the violet CN bands is brought out. In particular, the isotope effect, previously thought abnormally large for the initial state of the molecule, is now completely normal. Agreement with the theory is exceedingly good if the emitter is assumed to be SiN. No other assumed emitter gives agreement with the experimental data; even for SiO, the agreement is poor. Thus the value of the isotope effect in the identification of the emitters of band spectra, emphasised in a previous letter (April 5, 1924), is again confirmed. As in the case of the BO bands, so in the case of SiN, the testimony of the isotope effect is backed up by the chemical evidence (NATURE, Sept. 6, 1924, and *Phys. Rev.* 25, 259, (1925)).

The agreement of the results with theory is much better if the integral vibrational quantum numbers 0, 1, 2, . . . are assumed than if the half-integral numbers ½, 1½, 2½, . . . are used. In this respect SiN differs from BO, for which the data indicate (cf. refs. last cited) that half-integral values are needed.

A detailed account of the work on the SiN bands is now being prepared for publication.

ROBERT S. MULLIKEN,
National Research Fellow.

Jefferson Physical Laboratory,
Harvard University,
May 16.

Planetary Densities and Gravitational Pressure.

IN astronomical works the densities of the sun and planets are taken as the ratios of the masses to their apparent volume, the masses being determined by the periods of the bodies which revolve round them.

For the sun itself, and for several of the planets (notably for Jupiter and Saturn), the density so determined is much less than that of the earth, and it seems very improbable that this should really be the case, considering that the materials of which they are composed are the same as those which make up the earth, and that the gravitational pressure to which they are subjected is much greater than that which could be produced by terrestrial gravity.

In the case of the sun, Venus, Jupiter, and Saturn, in which the visible part is vapour or cloud, it seems most likely that there is a dense nucleus in which most of the mass is concentrated, and, assuming for the moment that the whole mass is so concentrated, it is a simple and direct problem to determine the size of the nucleus for any given density.

The depth of the non-solid covering will be the difference between the apparent semidiameter and the radius of the nucleus, and if the latter has the density of the earth, the approximate dimensions in miles are as follows:

	Apparent Semidiameter.	Radius of Nucleus.	Thickness of Envelope.
Sun . . .	432,000	278,000	154,000
Venus . .	3,800	3,600	200
Jupiter . .	45,000	28,900	16,600
Saturn . .	37,500	19,000	18,500

If the density depends on the gravitational pressure, the diameter of the nucleus will be less than the above for the sun, Jupiter, and Saturn, and rather greater for Venus.

There are no experiments on the variation of density of solids under large pressures. If a rod of the mean density of the earth is supposed to reach from the surface to the centre, the pressure on its base is just half that which the same mass would exert at the surface when resting on the same area. Taking the earth's radius as 21 million feet and the earth's density as 5·6, this gives 11,400 tons per square inch as the pressure at the earth's centre.

I have seen no mention of trustworthy experiments at even 100 tons per square inch, and in my own work have never gone beyond 30 tons.

In some trials with precipitated chalk, using pressures of 25 tons to the inch, I have obtained blocks with a density of 1·6 to 1·7—much the same as the density of the upper chalk. In the lower chalk, however, the density sometimes exceeds 2, and it would be interesting to know whether this is the result of gravitational pressure.

A. MALLOCK.

Spiral Springs of Quartz.

I AM greatly interested in the account in NATURE of June 20, p. 943, of the manufacture of spiral springs of fused quartz by Dr. Sliupas, and the comment by Prof. Boys on the achievement.

During the last eighteen months we have been employing similar springs of fused quartz in this laboratory in the measurement of sorption, a preliminary announcement of their use appearing in the Journal of the Am. Chem. Soc. for December of last year (Bakr and McBain, p. 2722), and a full account of the sorption balance is now being communicated.

Our experiences confirm in every way the observations made by Dr. Sliupas in his letter. Several members of the laboratory have prepared these springs of varying dimensions, using the ordinary coal-gas-air blow-flame for forming the coil. (The oxygen-gas flame was, of course, employed for the drawing-out of the fibres from the thick rods of quartz.) The quartz fibre is attached by a smear of sealing-wax to an ordinary arc-lamp carbon of suitable dimensions, which is supported in a well-bored cork, so that it may be rotated about its longitudinal axis. A small weight is suspended from the free end of the fibre, which is then coiled by slowly turning the carbon rod, the fibre being heated by the blow-flame at the point

at which it is being bent. As mentioned in Prof. Boys's note, the close or open coiling of the spring may be effected by slight inclination of the rod to the horizontal, and evenness in the winding is readily secured. When the coil is completed, it is removed from the rod by gentle tapping, and the hooked ends bent into the axis of the coil. We have observed no deterioration of the quartz due to the contact with the hot carbon rod, or to the use of coal-gas.

Spirals of fused quartz fibres of from 0·1 to 0·2 mm. diameter, having from 15 to 30 coils of diameter 0·5 to 1·5 cm., have been prepared in considerable number. Some large springs with coils of 2 cm. diameter were made to order by Messrs. The Silica Syndicate, and these had the same average extension per unit weight suspended from them as the spring of the same dimensions instanced by Dr. Sliupas. Considerably more sensitive springs have been manufactured, but they were too delicate for the purpose for which they were required. There appears to be small limit to the sensitivity that can be obtained, provided that the maximum load required to be carried be small. As an example of a typical spring which we are employing—of the less sensitive kind—we can get a spring that will carry a total load of approximately 0·8 gram, giving an extension of 0·9 cm. per 0·1 gram load; diameter of coils, 1·3 cm.

In the manufacture of long springs we have found it quite easy to join two or more fibres together, using the oxygen flame.

H. GREVILLE SMITH.

The University, Bristol,
June 22.

The Quantum Analysis of New Nitrogen Bands in the Ultra Violet.

IN a previous letter (NATURE 114 642 November 1 1924), one of the writers predicted a new group of nitrogen bands with an origin at about 65 000, having for its initial state the final state of the first positive group, and for its final state the stable condition of the neutral molecule. A group of strong bands in almost precisely the predicted position has now been measured and analysed but contrary to expectations the progressions of this group are not related to those of any other analysed group of nitrogen, or of any other substance.

The new group was obtained with purified nitrogen at 0·003 mm. pressure, in a long tube, with flowing gas, using ordinary arc discharge. The spectrograms contain the usual nitrogen groups and in addition thirty bands degraded to the red extending from λ1354 to λ1854. Seventeen of the thirty have previously been observed by Lyman ('Spectroscopy of the Extreme Ultra Violet' pp. 82 and 113). The distribution of intensity except in minor particulars, is similar to that of the second positive group (a typical case), and hence indicates very definitely the correct assignment of vibrational quantum numbers. The resulting equation for the new group is

$$\nu = 68{,}956\ 0 + (1681\ 45n' - 15\ 25n'^2) - (2345\ 16n'' - 14\ 445n''^2),$$

where n'' varies from 0 to 9, and n' from 0 to 3 only, the average (Obs.–Calc.) being 0·1 Å.

There are many other bands (or at least hazy lines) between λ950 and λ1350, some of which are quite strong, and also a few rather weak bands between λ1350 and λ2100, but as yet no consistent numerical relations are apparent.

R. T. BIRGE
J. J. HOPFIELD

University of California,
May 11.

Sir William Fletcher Barrett, F.R.S.

IN Sir Oliver Lodge's notice in NATURE, June 6, p. 880, of the late Sir William Barrett he says that he (Sir William) "claimed" to have discovered some alloys of iron. Reference to published scientific papers would have shown Sir Oliver that Sir William read a paper in 1899, published in the Transactions of the Royal Dublin Society in January 1900, on the magnetic and electric properties of the alloy now known as stalloy, which is indispensable in the construction of transformers, dynamos, etc. Indeed he was told by an authority that this discovery had saved six million pounds in the construction of the Panama Canal alone. Another alloy, permalloy, is likely to be of even greater use in the future.

That Sir William did not do much more for original research was due to his extreme conscientiousness, in considering that, holding the chair of physics, his first duty was to his pupils, and no private work was ever allowed to interfere with that.

Sir Oliver further says that Sir William had "a stimulating hand in founding the Society for Psychical Research." It was entirely due to Sir William's initiative that the society ever came into being, in order to examine obscure psychical phenomena critically and scientifically. In this work he encountered much ridicule and hostile criticism, but he never suffered this or the undoubted obstacle thus created to his material advancement to hinder him in his arduous and devoted search for truth.

ROSA M. BARRETT.

I WELCOME Miss Barrett's supplementary letter about her brother's work. It is unsafe for a writer of an obituary notice to usurp the functions of a law-court to decide questions of priority or completeness of invention. "Stalloy" was, I believe, a subject of controversy, but those who knew Barrett well may hold that any claim made by him must have been well founded. As to the initiation of the S.P.R., Miss Barrett will find a notice in a forthcoming number of the Proceedings of that Society, wherein full credit is given him, with first-hand knowledge, by Mrs. Henry Sidgwick.

OLIVER LODGE.

A Geological Lecture Illustration.

THE following illustration, which occurred to me while preparing one of a series of talks to schools for the British Broadcasting Company, may be of interest to those who are concerned in teaching elementary geology, though it may not be new.

Almost every one has seen the heaps of sample carpets in large furniture stores. Let the carpets represent the successive strata as laid down in past time. Now suppose that a thick board or wedge be driven underneath the pile of carpets: this will produce a humping up of all the carpets just above the wedge. If we then suppose that the humped-up portion is subjected to continuous wear (denudation) it is quite conceivable that the upper carpets will be worn right through and the lower carpets (older strata) become exposed. The frayed edges of the worn-away carpets become the escarpments of the upper strata, and the analogy may be easily extended by considering carpets of different textures. Other types of deformation may of course be given to the pile, and the geological map subsequent on denudation easily deduced.

G. N. PINGRIFF

Merchant Taylors' School,
E.C.1.

Problems of the Rhone Delta.

By R. D. OLDHAM, F.R.S.

I.

IT has long been known that the delta of the Rhone has undergone great changes since the close of the period of Roman empire. The changes are attested by historical records, but the evidence is contradictory; in part it seems to indicate a rapid advance of the sea face of the delta during the Middle Ages, yet there are mentions of places and dry land almost up to the present limit, and there is clear proof that places close to the existing coast-line were dry land and inhabited during the Roman period. These contradictions gave rise to a large volume of discussion, at times very controversial, by archæologists, geographers, and geologists during the last century, but the result was inconclusive, for the key to the solution had not been found. Work done since the beginning of the present century has thrown a new light on the problem, and especially a geological study by M. G. Denizot, which was published in 1924 by the Société Géologique de France, has made a re-examination of the question possible, and led to the possibility of drawing an outline of the changes which have taken place since the dawn of our era.

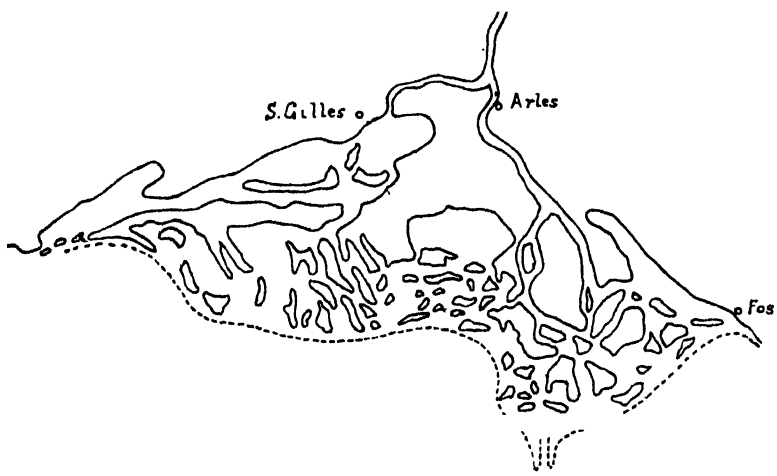

FIG. 1.—The Rhone delta about the end of the tenth century. This sketch does not attempt accuracy of detail; it is purely diagrammatic and intended to represent the general type of topography which resulted from the subsidence in the Dark Ages. The outline of the waterways must have been more intricate than can be restored, or represented, on a small scale map. The broken line represents, approximately, the outline of the delta in Roman times.

On a map of the region, the river Rhone is seen to divide just above the city of Arles into two branches, of which the western flows past St. Gilles and, curving to the southwards, enters the Mediterranean just west of the village and shrine of Saintes Maries, while the main stream, which carries four-fifths of the water, flows southwards to the sea, keeping near the eastern margin of the delta proper. Between these two streams is a triangular tract of country, known as the Camargue, and in the middle is an expanse of salt water, the étang de Vaccarès, which communicated freely with the sea by an island-studded stretch of water before it was cut off by the formation of an artificial protective embankment. As seen on a map, the appearance is that of a normal alluvial delta, where the two branches of the river are bordered by fully developed alluvial plains, while between them is a tract of marshy or flooded country, not yet fully reclaimed from the sea, and as such it has generally been interpreted; some strips of ground, too high to be part of the alluvial plain, being regarded as relics of old coastal barriers, now separated from the sea by the advance of the delta.

The description of M. Denizot puts the question in a different light, for he describes the country round the étang de Vaccarès, on the north, the east, and west, as rising to heights of two to three metres, with an undulating surface, the result of subaerial denudation, and in the alluvium forming this high land, he found fossil remains of *Cardium edule*, and other living marine molluscs, at heights of more than a metre above sea-level. As cockles cannot live and thrive above high-water mark, it is evident that, since these deposits were formed below sea-level, there must have been an uplift of the land, and the relation of the present surface to the Roman remains, which are found in this region, shows that this uplift, though extremely recent in the geological sense, must have preceded the advent of the Romans, and probably of their predecessors, the Phoceans and Phœnicians.

Though very recent, this uplift is not the most recent change of level which has taken place. In 1903, Mr. R. T. Gunther established for the neighbourhood of Naples a series of regional changes of level, which ended up by leaving the land some twenty feet lower, relative to the sea, than during the Roman period, and, since then, evidence has accumulated of a similar change of level in other parts of the Mediterranean, from Venice to Alexandria and Carthage, nor is it wanting along the coast of Provence. In the very region of the Rhone itself, remains of Roman buildings have been found below sea-level, in the étang de Vaccarès; and in the Gulf of Fos are remains of old buildings, regarded as remains of the port of Fossæ Marianæ, which was an important seaport in the early centuries of our era.

A very vivid description of these is given by M. Toulouzan, who mentions buildings, and long jetties of stone, as visible beneath the sea in calm weather. The archæology of this writer was so brightly tinged with imagination, that the existence of these ruins has been doubted, or denied, but there is independent evidence of the remains existing under the sea in the Golfe de Fos, and the discovery of remains of Roman construction below sea-level has also been recorded in the étang de Vaccarès. Apart from this, M. Denizot, in the paper referred to, gives evidence of subsidence of the land near Fos, though he denies the possibility of its amounting to anything like nine metres. That some

subsidence of the land has taken place is, therefore, established, but the direct evidence on record, if we except the statements of M. Toulouzan, does not give a measure of it. For this we must look to the changes which have taken place in post-Roman times, which not only give indirect corroboration of the subsidence, but enable its amount to be estimated, as certainly not materially greater than five, or less than four, metres, and the date to be fixed as in the period which elapsed between the beginning of the eighth and the close of the tenth centuries.

One result of the recognition of this change of level is that the current conceptions of the delta in Roman times must be revised. The whole region then stood some twelve to fifteen feet higher above sea-level than at present, and, if the land were again to be raised to this level, the whole of the great expanse of water, forming the étang de Vaccarès and extending to the sea, as well as all the salt lakes, which are in more or less direct communication with the sea, or only cut off by alluvial and coastal barriers, would be converted into dry land. The delta, instead of being smaller than at present, might have extended farther out to sea than now; the great spreads of pestiferous salt marshes, which render the country almost uninhabitable, would be largely or entirely drained, and instead of the subsoil being everywhere so charged with salt that a supply of drinking water can only be procured by storing the rainfall, it would probably be obtainable from surface wells. The country, in fact, would be fertile and habitable, justifying the description of the ancient writers, and accounting for the numerous remains of considerable settlements which have been, and are still being, found. Through this region the branches of the Rhone would flow in channels cut out of the upraised alluvium, with a flood-plain on either side, and the mouths would issue on the sea-face, where the action of the waves, driven directly against the bar by the prevailing storms, would give rise to the same difficulties and dangers of navigation as at present, troubles which Caius Marius solved, in the same way as the French engineers of the last century, by cutting a ship canal from the river to the sea.

With the subsidence in post-Roman times, a change in the conditions took place. In a region where no point rose more than thirty feet above sea-level, the whole of the low lands would be submerged to a greater or less extent; numerous creeks and channels would penetrate the land, converting the gently undulating ground into islands of varying size, separated by channels of varying width and depth; the river, instead of ending on the exposed sea-face of the delta, would debouch into deep and sheltered inlets of the sea; the conditions leading to the formation of a shallow and dangerous bar would be mitigated, and the entry made possible for ships of greater draught and tonnage than before or at present. In the network of channels and expanse of shallow water, resulting from this subsidence, the recovery of land from the sea, by the alluvial deposits of the river, would take place with rapidity, the position of the mouth, and the course of the channel, would be continually changing, until the river once more reached the sea-front of the delta. One region, however, was protected by the accident of configuration of the surface, and while, on either side, the channels were largely filled up by river silt, the great étang de Vaccarès, with the island-studded waters to the south, remained little affected, and have preserved a representation of the conditions which must have been widespread, along the whole of the outer portion of the delta.

Besides the numerous salt lagoons, or étangs, which owe their origin to this subsidence, there are expanses of modern alluvium, which, but for the complete embankment of the river, would still be in process of formation. This modern alluvium, according to M. Denizot, can often be sharply distinguished from the older, prehistoric alluvium, on the undulating, eroded surface of which the Roman settlements were built; in other places the boundary is less easily recognised, but the distinction is none the less complete, and it is largely possible, by an examination of modern maps and a comparison with older ones, to extend his direct observations, and to compile a map which will, at least, give an indication of the general distribution of land and water at the time when the subsidence had ceased, and before sedimentation had been able to make material progress.

Such are the deductions which may be drawn from a purely geological study of the region. It remains to be seen how far they are consistent with, or supported by, historical records.

II.

The western branch of the Rhone, which takes off from the main stream just above Arles, flows past St. Gilles and then bends southwards to enter the sea by the Grau d'Orgon, near Saintes Maries, but the last part of the present channel, from Silvéréal on, dates only from 1552, when the river broke away from its old course. Before that date it had followed another channel, farther west, now known as the *Rhône mort*, past Peccais, to the salt lagoons south-east of Aigues-mortes, and in 1532 was diverted from them by a cut direct to the sea, which became known as the *Rhône vif*, the mouth of this channel becoming the *grau neuf*. Between St. Gilles and Silvéréal the river crosses a great expanse of marsh and swamp, which extends westwards towards the étang de Mauguio, and is separated by a barrier of slightly higher land, an inland delta of the Vistre and Vidourle. M. Denizot refers to this tract, which he recognised as composed of modern, or as we may say, post-Roman alluvium, quite distinct from, and newer than, the older alluvium forming the more elevated undulating surface to the south of it. Even now the greater part of this ground can scarcely be described as dry land; it is mostly swamp and, in all but the most recent maps, considerable tracts are shown as permanently flooded. It bears all the appearance of being a tract which has been reclaimed by river deposits in quite recent times. A relic of this old, and once extensive, sheet of water, which spread over this ground, may be seen in the étang de Scamandre, still about six feet in depth, and evidently bounded by the sloping surface of the alluvial plains of the Rhone on the east and the Vistre on the west.

It is not possible, from the information available of a geological or topographical character, to determine whether this sheet of water formerly extended westwards to the étang de Mauguio; for this we must look

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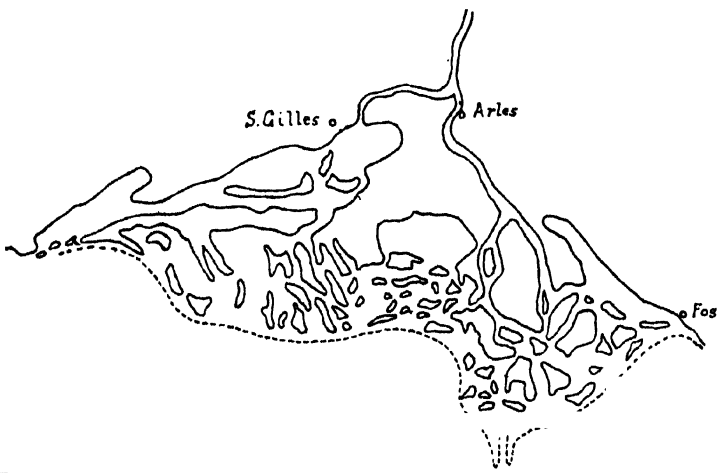

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Such are the deductions which may be drawn from a purely geological study of the region. It remains to be seen how far they are consistent with, or supported by, historical records.

II.

The western branch of the Rhone, which takes off from the main stream just above Arles, flows past St. Gilles and then bends southwards to enter the sea by the Grau d'Orgon, near Saintes Maries, but the last part of the present channel, from Silvéréal on, dates only from 1552, when the river broke away from its old course. Before that date it had followed another channel, farther west, now known as the *Rhône mort*, past Peccais, to the salt lagoons south-east of Aigues-mortes, and in 1532 was diverted from them by a cut direct to the sea, which became known as the *Rhône vif*, the mouth of this channel becoming the *grau neuf*. Between St. Gilles and Silvéréal the river crosses a great expanse of marsh and swamp, which extends westwards towards the étang de Mauguio, and is separated by a barrier of slightly higher land, an inland delta of the Vistre and Vidourle. M. Denizot refers to this tract, which he recognised as composed of modern, or as we may say, post-Roman alluvium, quite distinct from, and newer than, the older alluvium forming the more elevated undulating surface to the south of it. Even now the greater part of this ground can scarcely be described as dry land; it is mostly swamp and, in all but the most recent maps, considerable tracts are shown as permanently flooded. It bears all the appearance of being a tract which has been reclaimed by river deposits in quite recent times. A relic of this old, and once extensive, sheet of water, which spread over this ground, may be seen in the étang de Scamandre, still about six feet in depth, and evidently bounded by the sloping surface of the alluvial plains of the Rhone on the east and the Vistre on the west.

It is not possible, from the information available of a geological or topographical character, to determine whether this sheet of water formerly extended westwards to the étang de Mauguio; for this we must look

to historical records, and foremost among them may be put the history of St. Gilles. By some writers this place has been identified with the Heraclea, mentioned by Pliny the younger, on the strength of a supposed inscription, which has been wholly discredited by later research. That a Roman town stood where it now stands is certain, but this was not Heraclea, for Pliny mentions that place as one which had become legendary, even in his time, and there is not only no evidence, but a strong presumption, that the St. Gilles of Roman times was not in use as a port. It was otherwise in the eleventh and twelfth centuries, when the Dark Ages were passing away, for at that time St. Gilles was not only a recognised seaport, but also the most important one along this coast. In 1109 Raymond of St. Gilles collected there a fleet of forty ships, to transport an army of four thousand fighting men to the Crusades. Three years later the Knights Hospitaller of St. John founded their first establishment outside the Holy Land at St. Gilles, because it was then the port most used by pilgrims to and from Jerusalem. Mention of the use of St. Gilles is fairly frequent in the records of the twelfth century, and in 1160 the Rabbi Benjamin of Tudela describes it as a flourishing town frequented by visitors from the most distant lands, situated on the banks of the Rhone, and within three miles of the sea. As the sea is now nowhere within five times that distance of St. Gilles, and as there is a continuous strip of what must have been dry land, though possibly penetrated by channels, the sea of the Rabbi could not have been the Mediterranean; it could only have been that expanse of water which has been referred to.

These accounts give no clue as to the direction in which the navigable channel of access lay, but an incident of the wars between the republics of Genoa and Pisa throws light on this subject. Some Pisan galleys, pursued by Genoese, took refuge by ascending the Rhone to St. Gilles; the Genoese, instead of following them, went up the main stream, past Arles and, rounding the point of the Camargue, descended the lesser branch of the river to St. Gilles. The Pisans hearing of their approach fled down stream, as the chronicle reports, by another river and another mouth called the Gradus Capræ, which appears in the French version as Grau de la Chêvre, where the Genoese, in pursuit, captured and burnt some of the galleys and proceeded, searching for more, until they reached the Grau de Montpellier, now called Palavas, where they met a contrary wind and had to return by the river to Arles and so on to Genoa.

This is the last appearance in history of St. Gilles as a port accessible from the sea. In the following century, when Aiguesmortes was founded, in 1240, St. Gilles could no longer have been a seaport; it is certain that there was no direct access to it from the étang de Mauguio, and the Grau de la Chêvre of the thirteenth and fourteenth centuries was the mouth of the old river course, of the *Rhône mort*. This channel, however, seems not to have been navigable, and it is very questionable whether it was meant, in the record of the naval adventure of 1165; if the statement of the Rabbi Benjamin of Tudela can be accepted, the river had not then extended so far, and the narrator, without definitely stating it, implies that the course from the Grau de la Chêvre to Montpellier was in sheltered waters, and not in the open sea. The implication is that the access to St. Gilles was from the westwards, and if so its decline and disappearance, as a port of destination, was due to the closing of this channel on one hand, and the advance of the western and smaller branch of the Rhone on the other.

This conclusion is strongly supported by a study of those remarkable relics of the Middle Ages known as the portolan maps. It is known, from incidental references, that sea-charts of some kind were in use in the twelfth century, but they appear to have been mere sketches, drawn from memory by navigators, of the approaches to individual ports, or of stretches of coast-line; only towards the end of the thirteenth century did the normal portolan appear. This gave a representation of the Mediterranean and Black Seas, and of parts of the Atlantic coasts of Europe and Africa, with a surprising degree of accuracy. The origin and history of these maps have been the subject of much discussion, but it is generally agreed that they were sea-charts made for the use of sailors, that they originated independently of, and were uninfluenced by, any earlier maps, and that, once the type had developed, they went on being reproduced, with merely variations in detail, throughout the succeeding centuries until the seventeenth or even into the eighteenth century.

In the region of the Rhone Delta, the maps all represent a broad inlet of the sea, stretching from Cette to the Rhone, drawn in a conventionalised outline and dotted over to represent shoal water. To this statement an exception must be made of a few of the earliest maps; in the very earliest, the Carte Pisane of the end of the thirteenth century, the representation of the mouth of the Rhone is so purely conventional that no conclusion can be drawn from it; of slightly later date, 1318, are two maps by Petrus Vesconte, of very different character and great interest. They represent a great inlet of shallow water, extending from just east of Cette, over the étang de Mauguio to beyond where St. Gilles would be, were it marked on the map; and, more than that, one of these maps also shows a sheet of water, north-eastwards of the termination of this inlet, in the position of the tract of land, between St. Gilles and Beaucaire, which was permanently flooded until it was drained by the digging of the canal from Beaucaire to Aiguesmortes. In neither of these maps does the inlet extend to the Rhone, but stops short, and at the eastern end a river is shown entering it, which must be meant for the western branch of the Rhone.

FIG. 2.—Coast-line between Cette and Cap Couronne, from the Catalan Atlas of 1375. This shows the general type of the representation of the Rhone Delta, which runs, with small variations, through the whole series of the portolan maps, with the exception of the early one by Petrus Vesconte, shown in Fig. 3.

It is impossible to examine these maps without being struck with the facts, that they evidently owe nothing to any pre-existing map of which we have any knowledge, and that they are equally evidently an attempt to represent something which really existed. The author of the general map must have had before him a local chart of this region, probably one of those mentioned above, which had been drawn at a time when St. Gilles was still a port; but this was a century before

the map was drawn, and so the omission of the name of St. Gilles can be accounted for. Vesconte knew that there was no longer a port of St. Gilles, if he knew that there ever had been, and, being of no interest to those for whom the map was made, it was omitted, but the topography he took, directly or indirectly, from the older map. If this map is compared with a restoration of the twelfth century topography, as deduced from modern maps of the region, the agreement, as regards the eastern end of the inlet, is so close, that his representation of the western portion, where direct restoration is more uncertain, may be taken as corroboration of the western approach to the port of St. Gilles.

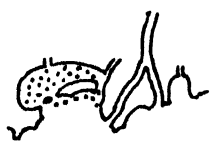

FIG. 3.—Coast between Cette and Cap Couronne, from the map by Petrus Vesconte, dated 1318.

The later history of these maps, so far as it affects this region, may be briefly summed up. The Vesconte map is the last which gives an air of reality to the western channel, and it is probable that in contemporary maps, by other makers, the representation had already assumed the conventional form, seen in the Dulcert map of 1339, and repeated throughout the series of later maps. At the same time, there is a great advance in the representation of the sea face, which maintained a remarkable correctness until about the middle of the fifteenth century; after that, a change of conditions, by deterioration of the channels of access to Arles and Aiguesmortes, and by the increase in size of the merchant ships, led to this coast being avoided by the mariners who used these charts, and a steady deterioration set in, due to errors introduced by repeated copying, uncontrolled by any check.

From the evidence outlined above we may reconstruct the history of St. Gilles as a seaport. In Roman times it was an inland town, of no great importance, past which one of the branches of the Rhone flowed, as at the present day, but, instead of turning southwards, the river flowed on to the west, in a valley cut out of the upraised alluvium, to where the étang de Mauguio now stands. Then came the subsidence in the Dark Ages, the lower part of this valley became submerged, and an inlet of the sea was formed, with sufficient depth of water to enable ships to reach St. Gilles, which, by 1080, had become so well established that it was selected as the most appropriate landing-place for a princess of Sicily, on her way to the Court of France. The importance and prosperity of the port increased during the succeeding half-century or more, but, once further subsidence of the land had ceased, the alluvial deposits of the river began to advance into the flooded lands until St. Gilles, instead of being a port on an inlet of the sea, became a town on the banks of a small river, and at the same time the rivers Vistre and Vidourle, entering the inlet near its western end, built up a barrier across it. These two causes, combined, made access from the sea to St. Gilles increasingly difficult until, by the end of the twelfth century, its life as a seaport had come to an end. Since then, the remains of this old inlet were gradually filled up by silt deposited from the flood-waters of the rivers, and the process would still be going on, if these rivers had not at last been completely hemmed in by flood-proof embankments.

(To be continued.)

The Centenary of the Railway.

By Engr.-Capt. EDGAR C. SMITH, O.B.E., R.N.

THE celebration of the centenary of the opening of the Stockton and Darlington Railway is an occasion of world-wide interest, for from that pioneer line has sprung the vast network of railways which stretches to the uttermost parts of the earth. It was the first of British public steam railways, and just as the Romans were the great builders of roads, so our race became the great builders of railways. Even as British ships navigate every sea, so railways designed by British engineers traverse every continent. The modern textile industry and the steel industry both had their birth in our isles, but it is probable our three greatest contributions to material progress were the steam-engine, the steam-ship, and the locomotive. Watt and Stephenson, like Shakespeare, Newton, and Faraday, have been eulogised beyond measure, but we are perhaps even now too near the revolutions they set in motion to realise their full significance in the history of mankind.

The Stockton and Darlington Railway was opened on September 27, 1825, when George Stephenson drove his famous engine *Locomotion* from Darlington to Stockton with a train of miscellaneous vehicles and trucks filled with goods and passengers. That great experiment must always be associated with the name of Stephenson, who, however, was but the outstanding representative of the pioneers of the steam railway to whom tribute should be paid. Tracks of wood and wheels of iron had been in use for many years. In 1801 William Jessop had built the first authorised public line, the Surrey Railway. It was probably Jessop who gave us our gauge of 4 ft. 8½ in. By 1820 railways were becoming common, and no fewer than twenty were sanctioned in that year alone. These were worked by horses. In the eighteenth century, Cugnot, Murdock, and Trevithick had all built steam-carriages; and in 1804 Trevithick set a locomotive to work on an iron track in Wales. In this engine he used the exhaust steam as a blast. Two or three years later Trevithick had one of his engines running round a track where Euston Square now stands. Blenkinsop's engines with cogged wheels date from 1812, and about the same time Foster and Hackworth assisted Hedley to construct *Puffing Billy* and *Wylam Dilly*, the two oldest locomotives now extant. Stephenson's first Killingworth engine *Blucher* was built in 1814, his second in 1815, and eight years later, with assistance from Pease, Richardson, and Longridge, he opened his engine factory at Newcastle, where *Locomotion* was built.

Originally projected by Edward Pease as a mineral line for bringing coals from near Bishop Auckland to the sea, the plans for the Stockton and Darlington Railway were passed in 1821, and two years later, largely through Stephenson, powers were obtained for

carrying passengers and for using locomotives, the general idea being to use locomotives on the level and stationary winding engines for the inclines. At first *Locomotion* was the only locomotive, but it was soon followed by other engines afterwards named *Hope, Black Diamond, Diligence,* and *Royal George,* for it was found that "an intercourse and trade seemed to grow out of nothing." Stephenson by now was also engineer to the vastly more important railway, the Liverpool and Manchester, and just as he had prevailed upon Edward Pease to use the locomotive for the Durham line, so he converted the proprietors of the Lancashire line to his ideas. When the line was nearing completion a prize of 500*l.* was offered for a locomotive fulfilling certain conditions, and the remarkable success of the *Rocket* at the historic Rainhill trials held in October 1829 sounded the knell of both horse railway and stationary-engine railway. A year later the Liverpool and Manchester Railway was formally opened by a procession of eight locomotives, headed by the *Northumbrian*, driven by Stephenson, and with that event the era of the steam railway set in.

Railway progress since those early days has been due to two great schools of engineers: the mechanical engineers devoted to the design and construction of rolling stock, and the constructional engineers responsible for the track. To the former belong both George and Robert Stephenson, Hackworth, Bury, Crampton, Gooch, Fairlie, Ramsbottom, Baldwin, Webb, Belpaire, Borsig, de Glehn, Mallet, Pitkin, and Vauclain, whose names have been household words. Between the *Rocket,* weighing with her tender 7¼ tons, and the giant *Virginia*, built by the American Locomotive Co., weighing 450 tons, lies the work of a great army. With her fire-box surrounded with water spaces, her copper tubes and her direct drive, the *Rocket,* compared with anything which had gone before, was as a racehorse to a dray horse. It was in the *Planet,* however, that the cylinders were placed under the smoke-box with the driving wheels aft as we have them to-day.

In the history of the locomotive it is impossible to say too much for Howe's invention of the link gear, which gave the driver a simple means of reversing, and also of regulating the cut-off in the cylinder. The link gears of Walschaerts, Gooch, Allan, and Joy were all later than Howe's invention, which was made in 1842. Other landmarks in the history of the locomotive are the brilliant invention of the injector by Giffard, the introduction of his ingenious water trough by Ramsbottom, the use of compounding by Mallet and Webb, and the introduction of superheating, notably by Schmidt. But in truth every part of the engine and boiler, tubes, valves, gauges, cylinders, pistons, springs, bearings, axles, and cranks, have been the subjects of close investigation and continual improvement. In the development of rolling stock, special mention should be made of the invention in 1869 of the Westinghouse brake, while we are also indebted to the United States for the Pullman carriage and the Swift refrigerator car. Scientific research has long been the handmaid of locomotive engineers, and it is worth recalling that August Wöhler's epoch-making work on materials began with the study of axles.

Just as Stephenson was the first to build an iron railway bridge, so he was the first to lay a line across a bog and to drive one through a hill. There can be no denying him the title of "the father of the railway." After the Liverpool and Manchester line came the London to Birmingham, then the Grand Junction continuing this line to Liverpool, and the South Western, South Eastern, and Eastern Counties Railways. With these and other railways at home and abroad are associated the names of Robert Stephenson, Locke, Brunel, Berkley, Errington, Vignoles, Bell, Hawkshaw, and Brassey. On some of the lines were works of great magnitude. Of the early bridges the most remarkable was the Britannia Bridge over the Menai Straits. Its originality, its great length, its height, and the audacity and skill displayed in raising the immense spans to the top of the towers created as much interest in the public mind as the building of the *Great Eastern* in the next decade. Robert Stephenson and Fairbairn were the engineers of the bridge, and for Fairbairn, Hodgkinson carried out his important inquiries on the strength of iron structures. The Britannia Bridge was opened in 1850. Five years later a railway bridge was thrown across Niagara by Roebling, and the year 1859 saw the opening of the Victoria Bridge over the St. Lawrence, of Lohse's bridge across the Rhine at Cologne, and of Brunel's bridge over the Tamar. These bridges, of course, were all built of iron, but with the steel age came even more remarkable structures, such as the Forth Bridge, containing sufficient steel to build two battleships, and the Victoria Bridge over the Zambezi River, high enough to overleap St. Paul's.

Less spectacular than bridge-building, but of equal importance in the development of railways, has been the art of tunnelling. The first railway tunnel was that on the Canterbury and Whitstable line. The elder Brunel's Thames tunnel, begun in 1824, was not a railway tunnel, but it led to the invention of the shield, which, improved by Greathead, has been used for all our tube railways. But the romance of tunnelling centres around the Alps. First came the Mont Cenis Tunnel, then the St. Gothard, then the Arlberg, the Simplon, and the Lötschberg. These have a combined length of 46 miles. It was in the Mont Cenis Tunnel, begun in 1857 and finished in 1871, that Graddoni and Sommeiller, through Colladon the physicist, first used compressed air, and it was reading of their work which gave Westinghouse the inspiration for his brake. To the lay mind there is nothing more marvellous than the boring of long tunnels from the opposite sides of a massive mountain range, and making them meet within a few inches. The total discrepancy in the alignment of the Simplon Tunnel, 12 miles long, was only 3⅞ inches. Tunnelling, like all railway work, may be said, in the words of Emerson, to be "girt about with a zodiac of sciences, the contributions of men who have perished to add their point of light to our sky." If men had not followed the motion of the stars, pored over the mystery of light, or studied fossil forms, the Alps would still have remained as great a barrier to the traveller as they were to the armies of Hannibal, and in commemorating the centenary of the railway we do homage alike to those who have enlarged the boundaries of knowledge and to those who have applied that knowledge to useful ends.

Current Topics and Events.

THE Committee which is to be charged with the responsibility of advising the British Government on Empire problems involving scientific investigation is to be called the Committee of Civil Research. A Treasury Minute issued on June 24 stated that it will be a Standing Committee reporting to the Cabinet, analogous in principle to the Committee of Imperial Defence. "The president of the Committee will be the Prime Minister, and the regular chairman, in the absence of the Prime Minister, will be a minister nominated by him for the purpose; the membership of the Committee will, as in the case of the Committee of Imperial Defence, consist of such persons as are summoned by the Prime Minister, or the chairman on his behalf. The Committee will be an advisory body and will have no administrative or executive functions. It will be charged with the duty of giving connected forethought from a central standpoint to the development of economic, scientific, and statistical research in relation to civil policy and administration, and it will define new areas in which inquiry would be valuable." We must confess that this announcement altogether destroys the high hopes raised by the statement made by Lord Balfour in the House of Lords on May 20. It cannot be too strongly urged that the analogy between the Research and Defence Committee has been carried too far. The expert is in the ascendancy at the Admiralty, the War Office, and the Air Ministry. He has considerable weight given to his opinions, and ministers are not infrequently forced to bow to his judgment on matters of defence. But in matters relating to scientific research in connexion with State departments, this is not the case. The permanent administrative officers in charge of departments are those to whom reference is made, and they determine whose and what advice is to be followed. Until more information is forthcoming regarding the new Committee, we hesitate to pass final judgment upon it. For the moment, however, it appears to us that the administrator has triumphed not only at the expense of the scientific worker, but also at that of the Empire as a whole.

IN the course of his reply in the House of Commons on June 29 to a motion of censure on the Government for its handling of the problem of industrial depression and unemployment in Great Britain, the Prime Minister, Mr. Baldwin, made some noteworthy remarks on the relation of scientific research to industry. "No one," he said, "will assert that British industry can be saved by science alone, but . . . until scientific methods and scientific men can take their place in industry, and an equal place with the administrator and the financier, British trade will never be strong enough or resilient enough to meet the sudden and unexpected changes which will always arise in international trade." Mr. Baldwin thinks that "the present situation in industry will cause our people more and more to turn their minds to what scientific research and scientific management can do." Speaking of expenditure on research, he stated that "the electrical industry to-day is spending a quarter of a million a year on research—an impressive figure for this country—but there is one company in the United States of America that is now spending 9,000,000 dollars a year and has 3000 trained workers in its research laboratories, and is going to increase that number to 5000, and there is no doubt that victory in the long run will go to the nation which can harness most efficiently and more securely science to its industry." He also referred to Government expenditure through the Department of Scientific and Industrial Research, and to the twenty-four industrial research associations now in being, in order to "show how I regard it as vitally important to link up science with our industries to-day and to say that the Government will always consider in what way they can best help in the attainment of this great object."

THE problem of low temperature carbonisation of coal received special mention in Mr. Baldwin's speech. The present position, according to Mr. Baldwin, is that "research has been going on at the Government station and by various processes in private hands, several of which have reached remarkable results so far as the laboratory is concerned. The time has not come yet when a commercial process has been successfully devised." He stated that he is convinced that "what has been proved successful in the laboratory will be proved successful commercially. . . . If the results of the new experiments at East Greenwich justify it, the Government will certainly consider the question whether they might not erect a plant upon a commercial scale to help in the development of this scheme."

THE third triennial conference of the International Astronomical Union is to be held at Cambridge during the week July 14–22 under the presidency of Prof. W. W. Campbell, formerly director of the Lick Observatory, and now president of the University of California. The meetings will commence with an inaugural ceremony at the Senate House of the University, when it is hoped that the Earl of Balfour, Chancellor of the University, will welcome the conference. The work of the Union is necessarily largely done at the meetings of its many committees, but the General Assembly will meet on four mornings for general business and for the ratification or modification of the reports of the committees. Among visitors from abroad who are expected to be present at the Conference we may mention Prof. Baillaud, M. le Comte de la Baume Pluvinel, Prof. Bigourdan, and General Ferrié from France; Miss Cannon, Prof. E. W. Brown, Prof. S. A. Mitchell, Capt. Pollock, Dr. St. John, Prof. Schlesinger, Prof. Shapley, and Dr. van Maanen from the United States; Prof. Cerulli and Prof. Abetti from Italy; Prof. W. de Sitter, Prof. Hertzsprung, Prof. Nijland, Prof. van Rhijn, and Prof. Zeeman from Holland; Prof. Chant, Dr. Henroteau, Prof. J. C. McLennan and Dr. J. S.

Plaskett from Canada; with Dr. H. Spencer Jones and Senator A. W. Roberts from South Africa; Dr. Comas Sola and Prof. Herrero from Spain; Prof. Nagaoka from Japan; Prof. Zeipel and Dr. Lundmark from Sweden; Prof. Stroobant from Belgium; Prof. Voûte from Java, and Prof. Wolfer from Switzerland. The tale is far from complete, but it is clear that Prof. Fowler, the secretary of the Union, may look forward confidently to a successful gathering and to much useful work being done.

WE have received from Prof. E. H. L. Schwarz, of Rhodes University College, Grahamstown, a letter claiming the recent age of the Taungs skull, on the ground that the change in geographical conditions at the locality may be of modern date, in accordance with his view that the climate of South Africa has undergone a great desiccation in the course of the past century. He therefore considers that forests suitable for great apes may have survived near Taungs until recently. Prof. Schwarz adds: "The Taungs skull was associated with a large number of brain casts of young baboons. Mr. F. Y. FitzSimons informs me that the cave-dwellers of the Zitzikamma used to eat young baboons; the rock shelters are full of bones, but the skulls are all intact, showing that the men did not fancy eating the brains. It is probable, therefore, that the young Australopithecus, whose remains have been preserved to us, had been caught as prey by a man of the period. What nature of a man was he? When the bone breccia of Broken Hill, Rhodesia, was first discovered, some very distinctive stone implements were found in it; it was only long afterwards that the skull of Rhodesian man was found in the same deposit. The artefacts are made of clear vein quartz, and are of quite a different type from all other South African ones. I had previously obtained them from the Great Brak River, Mossel Bay, while we have almost identical ones in the Albany Museum, from the Bezuidenhouts River, Johannesburg. The Rhodesian race was, therefore, widely distributed throughout South Africa, so the man who snared the young Australopithecus probably belonged to it."

A SCHEME for a very large transmission network for electric power in the eastern part of the United States will probably come into operation in the immediate future. It will link together Washington, Baltimore, Philadelphia, New York and Boston with two of the principal coal-fields in America and with a hydro-electric station obtaining power from the St. Lawrence Rapids. Many small water power plants in the mountains of New York State will also be linked with the network. As the St. Lawrence Rapids are about 300 miles away from the centre of distribution, it is proposed to use the very high pressure of 300,000 volts. As 220,000 volts are already used in California, the American engineers do not anticipate any difficulty. To diminish the inductance of the transmission lines and to prevent brush discharges, several aluminium conductors in parallel will be used instead of one copper conductor. The very large steam plants in New York, Philadelphia, and Boston, all of which obtain their coal by water transport, will supplement the steam power plants in the mine fields and the hydro-electric plants. Luckily abundant feed water is obtainable near the mine fields. The hydro-electric plants will run at full load continuously, the steam plants only being used when the demand exceeds the capacity of all the hydro-electric plants. All manner of labour-saving devices and apparatus for increasing the efficiency can be employed in very large power stations. It is estimated that when this scheme is put into operation, it will save millions of tons of coal per annum, as well as greatly increase the total power available.

ON June 25 the Johnston-Lavis Geophysical Collection, bequeathed to University College, London, under the will of the late Dr. Henry Johnston-Lavis, formerly professor of vulcanology in the University of Naples, was formally thrown open to the public by Sir Henry Miers. The collection contains a complete and unique series of specimens, maps, books, lantern- and microscope-slides illustrative of South American vulcanology since historic times, as well as collections of rocks and minerals from other parts of the world. The collection of Vesuvian minerals, in particular, is probably the finest in the world, and contains most of the species listed by Zambonini in his "Mineralogia Vesuviana." Of particular importance are the large number of specimens of the rare minerals aphthitalite, nocerite, and chlormanganokalite, the latter mineral being discovered by Dr. Johnston-Lavis himself in the eruption of 1906, and afterwards described by him and L. J. Spencer. The crystals of aphthitalite and idocrase described by France are also in the collection. There is, in addition to the Vesuvian and other minerals, a small but very fine collection of ores from the lead-zinc mines of Laurium, Greece, the smithsonites, aragonites, and aurichalcites deserving special mention. There is a large hanging geological map of Vesuvius, prepared by Dr. Johnston-Lavis, showing the distribution of all the lavas since historic times; and a large collection of guasches, coloured prints, engravings, etc., of past eruptions, and a unique library of vulcanological literature dating from 1508. The collection, which is temporarily housed on the two upper floors at 134 Gower Street, is available to the public for purposes of inspection or research on application to the office at University College, Gower Street, London, W.C.1.

THE American Ambassador, Mr. Alanson B. Houghton, unveiled a tablet in the library of the Royal Aeronautical Society on June 29 to the memory of the British and Americans who lost their lives in the wreck of the R. 38 on August 24, 1921. It will be recalled that the airship was built originally for the British Navy, but, on the decision being taken to abandon experimenting with airships, was sold to the United States. It was undertaking a flight carrying a mixed crew of Royal Air Force and United States Navy men together with some of the scientific staff of the National Physical Laboratory, when it broke its back and came down in the Humber,

only four of the crew being saved. Prof. L. Bairstow, in thanking the American Ambassador for performing the unveiling ceremony, stated that the failure of R 38 was a great misfortune to airship development. In his opinion, the airship would bring many achievements, which at present would be regarded as remarkable, within human range; for example, 24 hours from the limits of civilisation to the North Pole or 100 hours from London to India. He also referred to the development of methods of handling airships, and in conclusion stated that, as representing British scientific aeronautics, he hoped that progress would be based on knowledge—that is, research—as part of the tribute which the nations owed to those who had gone before.

SIR GEORGE A. WILLS, Bart., who with his brother the late Mr. H. H. Wills provided means for the erection of the new University buildings recently opened in Bristol by His Majesty the King, has promised a sum of 75,000*l.* for the extension of the Museum and Art Gallery buildings erected in 1904 by his cousin the late Lord Winterstoke. By this gift the exhibition space of the Museum and Art Gallery will be more than doubled, and a much needed opportunity provided of relieving the congestion in all departments which has become very marked during the last few years. The new buildings will be a backward extension of the present Art Gallery and Museum buildings and adjoining the new building of the University, with which they will be in communication. The site area is about 1860 square yards and will allow of the provision of store buildings and staff rooms. It is hoped the work will be completed in two years.

FURTHER details of his Arctic flight are given by Capt. R. Amundsen in his full story published in the *Times* on June 23. The position where he descended in order to take observations, and from which he afterwards returned, is now given as lat. 87° 43′ 2″ N., long. 10° 19′ 5″ W. While searching for a landing-place among the floes, Capt. Amundsen had been a little farther north. The two machines descended at some little distance apart. One was abandoned, the crew falling back with some difficulty on the other aeroplane, which was freed from the grip of the ice after long efforts. The chief difficulty then to be faced was the provision of a level run for starting. The rapid drift and continual screwing of the pack for a time destroyed all attempts. At length a track 1800 feet long and 36 feet wide was completed, and by reducing the load to 4180 lb. the explorers contrived to get a start. Then all went well until in close proximity to Spitsbergen they were forced to make a brief halt on the surface of a rough sea before reaching North Cape safely. Capt. Amundsen's full account of his journey reveals no scientific results of importance, and none was anticipated.

ON Friday, June 26, a meeting was held at Dorchester House, Park Lane, by the kind invitation of Sir George and Lady Holford, when Dr. G. Claridge Druce was presented with a book plate, the gift of 250 friends and members of the Botanical and Exchange Club. The presentation was made by Viscount Grey of Fallodon, who referred in his brief address to Dr. Druce's great botanical knowledge, and dwelt on the kindness which he has shown in putting that knowledge freely at the disposal of others, and his power of inspiring interest while imparting it. Dr. Druce replied, and expressed his thanks for the gift, and his pleasure that it should have been given by Lord Grey, whose love of Nature is so well known. He spoke of the work of the Botanical and Exchange Club, and referred also to the discoveries which have been made by the members in recent years and to the measures which are being taken to prevent the extermination of rare British plants. Dr. Scott then moved a vote of thanks to Sir George and Lady Holford for allowing the meeting to be held in their beautiful house. About eighty of the subscribers were present at the meeting.

IT was interesting to note at the close of the War that the Constantinople Museum, thanks in great measure to its Director, Halil Bey, showed less sign of disintegration than many other departments of public life. Nor was it long before its archæological activities were resumed, and useful work, if not on a very extended scale, was done. The Constantinople correspondent of the *Times* in the issue of June 25 describes excavations now being carried on by the authorities at Kadikeuy—the ancient Chalcedon. The foundations of a building about 90 feet long and built of big blocks, many roughly cut, have been brought to light. A fragment of stone containing a cross and surrounded by moulding suggests that the building probably was Christian, and may have been the famous church of St. Euphemia in which the Great Council was held in the year 451. Other signs of an active interest in archæology among the Turks are to be noted, especially the excavation of tumuli in Angora, the institution of a new branch of the Museum for Assyrian and Hittite monuments, and a new museum for objects of Turkish culture, as well as the projected formation of an ethnographical museum under Halil Bey and Jelal Essad.

SIR RONALD ROSS will open the new building of the British Mosquito Control Institute at Hayling Island, Hants, on Monday, August 31, when a party of members of the Section of Zoology of the British Association, which will then be in session at Southampton, will visit the Institute. The building has been designed to carry on work relating to the study and control of British mosquitoes, which was begun at Hayling Island in 1920 by Mr. J. F. Marshall and a local committee, and has resulted practically in ridding the Island of what was once an intolerable nuisance. The chief offender was found to be the salt-water mosquito *Ochlerotatus detritus*, which breeds in intertidal areas and is common at many seaside watering-places. Before any anti-mosquito measures can be carried out successfully, it is necessary to identify the chief species prevailing in a district, and as the work at Hayling has become known numerous specimens have been sent there for identification and for advice as to the best methods of dealing

with them. It seemed desirable, therefore, to provide a special building to deal with what has grown from a local to a national organisation, and this building, which will contain a demonstration museum, laboratory, drawing-office, photographic room, and other facilities for instruction and research on British mosquitoes and anti-mosquito measures, will shortly be completed. Among the distinguished entomologists and other naturalists who have consented to serve as members of the Council of the Institute are Major E. E. Austen, Dr. Andrew Balfour, Sir James Crichton-Browne, Col. S. P. James, Prof. H. Maxwell-Lefroy, Dr G. A. K. Marshall, Prof. E. B. Poulton, Sir Arthur Shipley, and Sir William Simpson.

IN pursuance of the policy already announced, by which the functions of scientific research and technical development, which were formerly combined in one directorate, have been divided between two directorates, both under the supervision of the Air Member for Supply and Research, Sir Samuel Hoare, Secretary of State for Air, has appointed Mr. H. E. Wimperis to be Director of Scientific Research, and Mr. D. R. Pye to be Deputy-Director of Scientific Research under the Air Ministry. Mr. Wimperis has been acting provisionally for some time as Director of Scientific Research. He received his engineering training at the Imperial College of Science, London, and at Cambridge. After several years with important engineering organisations he joined the engineering staff of the Crown Agents for the Colonies, and on the outbreak of war began his intimate association with aeronautics, undertaking experimental work both for the Royal Naval Air Service and the Royal Flying Corps, particularly with regard to navigational and armament devices. He became, on its inception in 1915, head of the Royal Naval Air Service, now the Air Ministry, Laboratory at the Imperial College of Science and has held that position continuously since. He is the author of several works dealing with the internal combustion engine and air navigation and of a number of scientific and technical papers. Mr. Pye is a fellow of Trinity College, Cambridge, and is at present lecturer in engineering at the College. He was trained at Cambridge, afterwards becoming chief assistant to Prof. Jenkin, who was in charge of engineering studies at the University of Oxford. During the War he joined the Royal Flying Corps, and was posted for duty as an experimental officer; later he served at the Air Ministry, acting as scientific assistant to Colonel H. T. Tizard, Deputy-Controller of the Technical Department. Since then he has been working at Cambridge, and has carried out research work in relation to aero engines.

A SEVERE earthquake is reported to have occurred on June 27 on the coast of California. Santa Barbara seems to have been most affected, and according to an account by the New York correspondent of the *Times*, the main street has been broken up and many of the buildings of the city destroyed. The High School, the County Hospital and the Arlington Hotel are referred to in particular as badly damaged. A seismic wave is stated to have flooded low-lying land along the coast. Twelve deaths have been reported. Shocks were also felt in Butte, Anaconda, Great Falls and Billings.

IN connexion with the 250th anniversary of the founding of the Royal Observatory, Greenwich, and to meet the delegates to the International Astronomical Union, the Royal Society is holding a conversazione on Thursday, July 23 at 9 o'clock.

PROF. BOHUSLA BRAUNER, Director of the Chemical Institute of the Charles University of Prague, has been elected an honorary member of the Russian Physico-Chemical Society, Leningrad.

COMMEMORATION DAY at Livingstone College, Leyton, was held on June 10. There was a good gathering of old students and others under the chairmanship of Dr. Andrew Balfour, who delivered an address. Dr. Tom Jays, the Principal, reviewed the work of the College during the past year and appealed for further funds, 800*l*. being needed to close the financial year without deficit.

A PARTY will leave London on July 31 for a holiday, lasting fifteen days, and for field work in geography, geology, botany and regional survey in the Vale of Chamonix and on the slopes of Mont Blanc. This area is classic ground. The members of the party will go over some of the ground covered by the pioneer workers H. B. de Saussure, Forbes, Tyndall, Vallot, and Ruskin, and attempt to continue their investigations. Particulars of the arrangements may be obtained by sending a stamped addressed envelope to Mr. Valentine Davis, Cheshire Training College, Crewe.

MR. P. MORLEY HORDER has been appointed architect for the permanent buildings of the London School of Hygiene and Tropical Medicine to be erected on the site adjoining Keppel Street, Gower Street and Malet Street, near the British Museum. It will be remembered that the funds for the erection of the new building are being provided by the Trustees of the Rockefeller Foundation who offered the British Government the munificent gift of nearly half a million sterling for site, building and equipment.

THE Jerusalem correspondent of the *Times* states in a dispatch which appears in the issue of June 19 that Mr. Jurville Petre, in the course of excavations by students of the British School of Archæology, has discovered the front part of a human skull of Neanderthal type in a cave near Tabzha, to the north of Tiberias. It is said to show the marked characteristics of the type in the highly developed supra-orbital ridges, the receding forehead, and the thickness of the bone. The cave in which it was found is below well-defined historical levels and contains, under a layer of fallen roof stones, a six feet couch of soil rich in Mousterian implements.

WRITING from Finsbury Technical College, London, E.C.2, Mr. H. M. Atkinson informs us that while cycling on June 21 from Norwich to Cambridge, he counted more than sixty dead birds on the road, including wrens, starlings, sparrows, finches and a

(?) hawk, together with several small rodents. Mr. Atkinson noted that birds rose and flew across the road at his approach but were able easily to avoid the bicycle. Apparently they are not so successful in avoiding motor-cars. Mr. Atkinson suggests that head-lights at night, or the polished, tarred road-surface itself during the day time, may have proved the attraction bringing the animals to the road, where they readily fall victims to fast traffic.

THE course of lectures delivered by Mr. W. A. F. Balfour-Browne to a juvenile audience at the Royal Institution last Christmas is to be published by the Cambridge University Press under the title of "Concerning the Habits of Insects." The same house will also issue Sir J. J. Thomson's Fison Memorial Lecture on "The Structure of Light." It is expected to be ready in July.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in the department of civil engineering, architecture, and building in the Bradford Technical College—The Principal (July 8). An assistant pathologist to the Jessop Hospital for Women and the Children's Hospital, Sheffield, and demonstrator of pathology in Sheffield University—The Registrar of the University (July 11). A senior research assistant at the Building Research Station of the Department of Scientific and Industrial Research—The Secretary, 16 Old Queen Street, S.W.1 (July 20). Two probationer naturalists (one with special qualifications in mathematics and a knowledge of biometry and statistics, and one with natural history qualifications, preferably with subsidiary physiology) under the Fishery Board for Scotland—The Fishery Board for Scotland, Edinburgh (July 31). Temporary assistant chemists in the Government Laboratory—The Government Chemist, Clement's Inn Passage, W.C.2 (July 31). The professorship of anatomy in University College, Dundee—The Secretary and Registrar, University, St. Andrews (August 1). The William Prescott chair of the care of animals—causation and prevention of disease—in the University of Liverpool—The Registrar (September 15). A lecturer on tropical hygiene at the London School of Hygiene and Tropical Medicine—The Secretary, 23 Endsleigh Gardens, N.W.1. Head of the commerce department of the Portsmouth Municipal College—The Secretary, Offices for Higher Education, Municipal College, Portsmouth. A physical laboratory steward at the Woolwich Polytechnic—The Principal. A woman teacher of physiology at the Chelsea Polytechnic—The Secretary, Chelsea Polytechnic, S.W.3. A technical assistant at the Royal Aircraft Establishment, South Farnborough, Hants, for work in connexion with photography, with special application to aerial photography—The Superintendent (quoting A. 76). A junior technical assistant at the Royal Aircraft Establishment, South Farnborough, Hants, for experimental work in aerodynamics—The Superintendent (quoting A. 75). A junior technical assistant at the Royal Aircraft Establishment, South Farnborough, Hants, for general physical work in connexion with instruments—The Superintendent (quoting A. 66).

Our Astronomical Column.

NOVA PICTORIS.—A letter from Mr H. E. Wood, of Johannesburg, contains the interesting announcement that the Nova has been identified with a star of magnitude 11·0, on the C.P.D. photographic scale, which appears on photographs taken with the Franklin-Adams Star Camera on March 17, 1914, March 18, 1914, February 10, 1921.

Its brightness before the outburst is slightly less than that of Nova Aquilæ 1918, and considerably less than that of T Coronæ.

The position for 1925·0 is R.A. $6^h\ 34^m\ 57^s{\cdot}2$, S. Decl. 62° 34′ 33″; annual precession $+0^s{\cdot}528$, S. 3″·02. Dr. H. Spencer Jones stated at the meeting of the British Astronomical Association on June 24, that the Cape photographs of the spectrum indicated the usual bright bands, but they showed less shift than was the case with most Novæ. The bands were less conspicuous 10 days after discovery, although the magnitude had risen from 2·4 to 2·0.

COMETS.—Several observations of Tempel's comet have been obtained. Its magnitude is about 11; as it approaches both earth and sun during July it will steadily brighten, but this is offset by its southward motion.

The following ephemeris for 0^h is by M. Ebell (B.Z. 24):

	R.A.	S. Decl	log r.	log Δ.
July 1.	$18^h\ 30^m\ 47^s$	4° 58′	0·140	9·578
9.	18 34 46	8 50	0·133	9·545
17.	18 40 27	13 40	0·127	9·522
25.	18 48 32	19 24	0·122	9·509

The comet is due south about 23^h. It is near ζ Aquilæ on July 9. This comet has the third shortest period of any known comet. Encke and Skjellerup (1922 I) come at the head of the list.

Mr. J. Larink has deduced a new orbit of Schorr's Comet (1918 III).

$T = 1918$ Sept. 28·603 G.M.T.
$\omega = 278°\ 38'\ 47''$
$\Omega = 118\ \ 0\ \ 33$
$i = 5\ \ 35\ \ 2$
$\phi = 28\ \ 5\ \ 1$

Period, 6·7071 years.

Mr. Larink finds 1925 May 27·90 G.M.T. (new) for the recent perihelion and gives the following search ephemeris:

	R.A.	N. Decl.	log r.	log Δ.
July 17.	$5^h\ 12^m\ 48^s$	19° 38′	0·274	0·418
21.	5 22 54	19 51	0·276	0·416
25.	5 33 0	20 1	0·278	0·413
29.	5 42 54	20 9	0·280	0·411

The comet was observed in 1918 more than three months after perihelion, so its detection this year is not hopeless, though the conditions are less favourable. Since it was discovered at Bergedorf, the astronomers of that observatory (to which Mr. Larink belongs) are making special efforts to recover it.

Research Items.

STONEHENGE.—The excavations in progress at Stonehenge have now covered the greater part of the site, only the north-western area awaiting examination. The sixth report on the results, which was presented by Col. Hawley on behalf of Mr. Newall and himself at a recent meeting of the Society of Antiquaries, deals with the south and south-west area. No objects of any importance were turned up; but a number of holes, some shallow, others reaching to a depth of 28 inches and ranging in width from 15 to 23 inches, were found. These pointed to the possible existence of a stockaded passage or long roofed building at this point, and it is conjectured that they were contemporary with the causeway at the main entrance, where similar post holes have been found. Nothing of the Stonehenge period had penetrated to the lower levels. Another causeway with pits in the ditch on each side of it was exposed. Seventy-one holes in all were discovered; but it is impossible to say what their use may have been, though they were too irregularly placed and too widely spaced to have formed a building. Further investigation has shown that the area of foreign stones must have held a much larger number than had hitherto been supposed, and they must have presented the appearance of a low wall. The discovery of a seventeenth-century glass flagon suggested that the removal of these stones had been comparatively recent.

UNITS OF MEASUREMENT IN ANCIENT EGYPT.—In *Ancient Egypt* for June, Sir Flinders Petrie puts forward and discusses a suggestion by Mr. J. Tarrell to account for the fact that the varying thicknesses of the courses of the great Pyramid tend to group around certain heights. The courses a dozen times or more start with a thick course, and dwindle until a thick course occurs again. An enormous number of blocks must have accumulated in the years of preparation. When the masons were ready to build, they shifted the quarrymen to another quarry and started sorting the blocks for each course according to size. This process was repeated from time to time, each thick course representing the beginning of a supply from a fresh source. The variations in thickness suggest the use of the cubit and double cubit, 20·6 and 41·2 inches, as the unit of a great number of the blocks, with a digit measure between, the groups being at 50, 40, 30, 32 (?), 34, 36, and 38 digits. Large exceptions point to local measures which may have survived into later times: 21·3 in. is the medieval Nilometer cubit; 22·2 in. the double foot of Syria found down to Roman times; 23·2 in. the double Roman foot, an ancient measure in Etruria; 26·3 in. the double of the northern foot (the foot of Germany and the basis of measurement in England which survives in the furlong and chain, and is important in France); 28 in. the Turkish *pik*; and 38·1 in. the Persian *arish*.

THE CRYSTALLINE STYLE.—Whereas in lamellibranchs a crystalline style is common, in gastropods it occurs in only a few genera. Mr. N. A. Mackintosh has given (*Quart. Journ. Micr. Science*, March 1925) a careful description of the style of Crepidula—the slipper limpet. The style, which is contained in a sac partially differentiated from the intestine, is a straight transparent rod of gelatinous consistency built up of co-axial layers surrounding a spiral core. It is composed chiefly of globulin and contains an amylolytic enzyme. The style and the style-sac resemble those of lamellibranchs so closely that they must be regarded as homologous in the two groups. A list of about two dozen gastropods is given in which the style is known to occur, and it is suggested that the style has been lost in all but a few gastropods, or that its appearance in this group is to be explained on the principle of orthogenesis.

GELATION AND SOLUTION IN CELLS.—In his report (Year Book No. 23) on the work of the Department of Embryology of the Carnegie Institution of Washington located in Baltimore, Dr. G. L. Streeter refers among other items to the work of Mrs. G. M. Lewis on gelation and solution in cells. When a culture of embryonic tissue is washed with a saline solution to which any of the ordinary acids has been added to give it a P_H of 4·6, the cells undergo coagulation and exhibit appearances which are regarded as characteristic of cell-death. The nucleus becomes granular and acquires a bright thick membrane; in the cytoplasm the granules cease their activity, and pseudopodia are not put out. If now, before the coagulation proceeds further, the acid solution is washed off, the cells recover their normal appearance, and such a culture if returned to the incubator may live as long and remain in as good condition as the controls; in other words the gelation is reversed. Such gelation can be brought about and reversed several times in succession. The cytoplasm can be made more fluid by means of a solution of alkalies with a P_H of 8·6 to 9. The cells, instead of remaining spread out on the cover glass, begin to round off, the mitochondria change from filaments to short rods and all the granules are in dancing movement. By bathing the cultures in normal solution the process can be to some extent reversed, but the cell never spreads out again, and such a culture does not live so long as the controls. One of the most effective acids in bringing about the gelation of living cells was that obtained from sterile dead tissue, and Dr. Streeter remarks that this fact should be of importance in explaining the toxic nature of crushed or burned tissue.

NUTRITION OF MYCORRHIZA PLANTS.—Dr. M. C. Rayner has published the results of further research on the nutrition of *Calluna vulgaris* (*Brit. Journ. Experimental Biol.*, vol. 2, January 1925, pp. 265-292). The most striking of these is the observation of regular and well-marked digestion of the mycelial constituents in the root mycorrhiza. Digestion begins soon after the production of young roots in the spring, is carried out throughout the growing season (during which mycelial activity reaches a maximum), and continues until growth ceases in the autumn. It cannot therefore be regarded as a phenomenon of senescence. The author shows that under certain conditions the roots may be infected by the fungus, but that typical mycorrhiza may not be established. By means of a special technique it is possible to find, in early spring especially, the hyphæ of invading root cells undergoing digestion before branching of the filaments can take place in the cells. This formation of suppressed mycorrhiza is regarded as highly significant, and is held by the author to explain the discordant results of previous workers. Assuming it to be correct, "the formation of mycorrhiza is a reciprocal phenomenon involving co-operation on the part of the root cells" and "represents a temporary phase of toleration on the part of the plant cell interposed between one involving immediate destruction of an entering hypha and the wholesale digestion of the mycelium which eventually takes place." It is held, in consequence, that the obligate relation in Calluna is associated with fungal infection and seedling development rather than with the subsequent stage of typical mycorrhiza

formation. The cytology of digestion, the distribution of the mycelium in the shoot, experiments with cuttings, and a general discussion on the nutritive relations in Calluna are other subjects dealt with in the paper.

WATER ABSORPTION BY LEAVES.—J. G. Wood has recently directed attention (*Australian Journal of Experimental Biology and Medical Science*, Vol. 2, pp. 45-56, 1925) to the remarkable capacity for water absorption possessed by the relatively uncutinised leaves of species of Atriplex. These plants, the "saltbushes" of Australia, are the characteristic plants over vast areas of dry plains, and as their root system is poorly developed, this power of absorbing water by means of the leaf system may be of considerable significance. It appears to be due to a remarkable accumulation of sodium chloride in the leaves of these plants. Even when growing in soil containing relatively small quantities, considerable accumulation of the salt occurs in the plant. As the result of microscopic examination of leaves placed in a solution of silver nitrate and then exposed to light, this accumulation seems to be most pronounced in the veins and in the chlorenchyma surrounding the veins.

RADIUM ORE DEPOSITS IN CENTRAL ASIA.—The presence of certain radioactive uranium minerals in Ferghana, Russian Turkestan, has been known since the beginning of this century. The centre where such deposits have been found is the Tuya-Muyun copper mine, where uranium was discovered long ago. More recently that mine has been studied extensively by several Russian mineralogists, geologists, and chemists, and since 1923 the mine has been regularly exploited. Results of the work of the expeditions recently published by the Russian Academy of Sciences show that the deposits are of great practical value as a source of radium; moreover, a study of geological conditions of the Ferghana province leads to the suggestion that radium deposits are not restricted to that mine only, but are much more widely distributed along the northern slopes of the Alai and Turkestan ranges. Further investigations are being carried on by the recently founded State Radium Institute of the Academy.

THE GEOLOGY OF SOMALILAND.—Mr. R. A. Farquharson's first report on the geology and mineral resources of British Somaliland, 53 pp., 1 map, forms a valuable contribution to the geology of East Africa. The report includes a general summary of the Somaliland sequence, which has recently been described in a monograph published by the Hunterian Museum of the University of Glasgow. To the sequence already known Mr. Farquharson's most important addition is that of a series of ancient unfossiliferous slates with interbedded limestones, for which he makes the interesting suggestion that they are the northern extension of the Karagwe Series of Kenya Colony and Uganda. The local Jurassic rocks he attributes entirely to the Kimmeridgian; but in the absence of any information as to the fossils he collected, it remains uncertain whether this identification is likely to stand, or whether he obtained them only from the upper part of the Jurassic. Mr. Farquharson's conclusions as to the age of some Kainozoic rocks do not agree in some respects with those based on the collections made by Messrs. Wyllie and Smellie, and an account of the author's fossils and his geological map will be awaited with interest. The longer section of the report includes an account of the occurrence of numerous economic minerals, some of which are regarded as promising, though nothing has been so far proved of commercial value under present conditions. In some of the specimens collected by the author, assays at the Imperial Institute record a trace of gold. The report is illustrated by a map in which, unfortunately, the place names are sometimes spelt differently from those in the text. The Las Khorai of the map is apparently Las Gori of the report. It is regrettable that a report issued at the end of April 1925 should be dated as if published in 1924.

THE PETROLOGY OF SAMOA.—Prof. R. A. Daly has written a very valuable account of the geology of Tutuila and the smaller American islands of the Samoan Group for Publication No. 340 of the Carnegie Institution of Washington. The average basalt of Tutuila is almost identical with that of Hawaii and with the average plateau basalt of the world. This close resemblance of the oceanic and continental basalts is strongly suggestive of a nearly uniform substratum below the heterogeneous crust. The alkali-trachytes and other intermediate rocks, occurring in Tutuila mainly as volcanic necks and dykes, are regarded as differentiates of ordinary basalt. The cause of the differentiation is, however, recognised to be still an unsolved problem, though the common eruptive sequence—basalt, trachyte, basalt—found in very many volcanic centres, receives a suggestive explanation. One of the domes of Tutuila is built up in part of quartz-trachyte similar to that of Ascension Island. It is remarkable as one of the rare examples of a lava in the open Pacific area containing primary quartz, and unique in being farther removed from a visible continental border than any other case yet described. It suggests to Daly that the submerged edge of Australasia may really extend as far to the east as Samoa. The lithification of beach sands is another problem which is fully discussed. The view is adopted that the formation and distribution of the "beach rock," as the firmly cemented sand is termed, are controlled by the action of the more violent storms. These are known to pile up calcareous sands over the normal beaches, and in their new position bacterial decomposition of the organic matter associated with the displaced shelf sands tends to precipitate calcium carbonate sufficiently to fix the grains. Further precipitation from the saturated tropical sea water then completes the process of cementation. Ordinary clean beach sands are not cemented because they are kept in incessant movement by wave-action.

THE RAYLEIGH SEISMIC WAVE.—Part 5 of Vol. 2 of the *Japanese Journal of Astronomy and Geophysics* contains a memoir of 93 pages by Mr. H. Nakano of the Central Meteorological Observatory, Tokyo, on the properties of the wave propagated along the surface of the earth due to some seismic disturbance in the interior. He finds that the wave does not make its appearance at the surface at a point immediately above the focus, but at distances from that point which depend on whether the originating disturbance is of the dilatational or distortional type. Its amplitude when it first appears at the surface is small and it does not attain its full value until the wave has travelled a distance along the surface which is large compared with the depth of the focus. The retardation of phase at each point of the surface is the same as it would be if the disturbance originated at the point on the surface over the source at the instant it actually originated at the source. The author hopes by a study of the laws of propagation in a laminated earth and comparison with observations to arrive at more definite conclusions as to the structure of the interior of the earth.

SURVEYS IN TIBET.—In the annual reports of parties and officers, 1921–22, which is published as a supplementary volume to the general report of the Survey of India for that year, there is a brief record, accompanied by a map, of the late Sir H. H. Hayden's surveys in Tibet in 1922. Sir H. H. Hayden, who was accompanied by an Indian surveyor, travelled through the central and south-eastern parts of the country to report on certain mineral-bearing areas for the Tibetan government. His routes lay between Lhasa and the great lakes of Tangra, Kyaring, Ziling, and Nam. Altogether some 36,000 square miles were mapped on a quarter-inch scale, of which only some 4000 miles had been previously surveyed: the remainder was known only from rough route surveys of the native Indian explorers Kishen Singh and Nain Singh, and the tracks of the few European travellers who had previously succeeded in penetrating this region.

BINARY ALLOYS OF ANTIMONY AND BISMUTH.—The equilibrium diagram of the binary alloys of antimony and bismuth has been already studied by several investigators. The results, however, do not agree well with one another, and a re-determination of the diagram has been carried out by Otani at the Research Institute, Sendai (Report No. 91). He has determined the liquidus and solidus by measurements of electrical resistance. With regard to the former, he measured the difference in potential between two fixed points in the specimen, both in the liquid and solid states. The current passed through the specimen for the measurement of the potential fall was 1·5 amperes, and the electrodes dipped into molten alloys were iron wires about 0·8 mm. thick. The rate of heating and cooling was about 1 degree per minute. The liquidus curve is found to be smooth and convex upwards. In the case of the determination of the solidus, the alloys were tested in the form of rods 5 mm. thick and 9 cm. long. These rods were made by casting the alloys in an iron mould and afterwards annealing them just below their solidus for a sufficiently long period to obtain a homogeneous structure. This was confirmed by microscopical examination. The temperature-resistance curves obtained on heating show that the solidus also is a smooth curve, which is concave upwards. The crystallisation interval in the case of the 50 : 50 alloy is nearly 200° C. This, of course, diminishes on either side. Thus the form of the liquidus and of the solidus in this system belongs to the ordinary type of solid solution where all points of the liquidus lie between those of the pure metals.

THE CURRENTS IN SUPRACONDUCTORS.—Supplement No. 50 of Communications from the Physical Laboratory of the University of Leyden contains a report by Prof. Kamerlingh Onnes of the results of the experiments on the mutual action of the electric currents in two supraconductors in the neighbourhood of each other. In one case the two supraconductors are concentric rings of lead in liquid helium with their axes horizontal and the inner ring supported by a long vertical fibre provided with a torsion head. The currents having been produced in the rings by the diminution of a magnetic field along their axes, the inner ring is rotated about 30° out of the plane of the outer by means of the torsion head. The rotation of the inner ring is observed by means of a mirror attached to it and is found to be invariable to within less than 1 part in 1000 for 6 hours. When the inner ring is replaced by a spherical shell also of lead and the experiment repeated, the torsional couple necessary to rotate the sphere is only one-third that for the ring. The author concludes that the paths of the electrons amongst the molecules of matter are fixed and unaffected by any transverse magnetic field.

DOMESTIC GRATES.—Technological Paper No. 13 of the Fuel Research Board is an account of the investigation of the relation between the design of a domestic grate and the heat radiated by it into the room, carried out by Dr. Margaret Fishenden under the auspices of the Manchester Air Pollution Advisory Board. The measurements show conclusively that diminution of the depth of a grate from front to back increases the heat radiated into the room per pound of coal consumed. Ease of maintenance of the fire limits this diminution in most cases to a minimum of four inches. The bars of the grate should be as slender as possible, and the grate should be visible from as large an area of the floor of the room as possible. Conduction losses through the back of the grate should be minimised by the use of firebrick instead of iron. The throat of the flue should be adjustable in area so as to permit regulation of the flow of air through the room, and an adjustable air inlet beneath the fire should be provided for the regulation of the speed of combustion of the coal.

PRECIPITATION OF RADIUM SULPHATE.—Sulphate ions will precipitate radium in the presence of a large excess of barium even though the solubility product of radium sulphate is not exceeded. H. A. Doerner and W. M. Hoskins have investigated this phenomenon and publish their results in the Journal of the American Chemical Society for March. At equilibrium, the reversible reaction

$$BaSO_4 + RaCl_2 \rightleftharpoons BaCl_2 + RaSO_4,$$

gives a distribution of radium and barium represented by the equation

$$Ra''(\text{final}) \times Ba''(\text{initial}) = K \times Ra''(\text{initial}) \times Ba''(\text{final}),$$

which is mathematically deduced from the principle that the radium-barium ratio of the precipitate ("crystal surface") is proportional to the radium-barium ratio of the solution. This equation is confirmed experimentally, K, obtained by several methods, being 1·8. The equilibrium is largely influenced by crystal growth. The possible application of the theoretical equations to adsorption, fractional crystallisation, etc., is discussed.

SOLID SOLUTIONS OF WATER AND OXYGEN.—The attention of chemists so far has been centred chiefly on compounds subject to the law of multiple proportions, but, according to N. S. Kurnakov (*Annales de l'Institut d'analyse physico-chimique de l'Académie de Science de Russie*, vol. 2, liv. 2, 1924), we must admit that this type of change is merely a particular case of a more general case—the constant change of the solid phase. Attention is directed chiefly to the ferrous compounds with a variable amount of oxygen and water in such substances as mica, tourmaline, hornblende, and also phosphorus salts. For these substances, the absorption of different amounts of oxygen does not affect the structure of the crystal, but creates continuous variations of colour and optical properties. The greyish-black, bluish-green, and blue colour of such substances is remarkable as being doubtlessly connected with the amount of absorbed oxygen. A very characteristic example is the mineral vivianite, which is a hydrated phosphorus oxide of iron, which may also be produced synthetically. In the early stages of their formation the crystals are nearly colourless, but become more blue as oxygen is absorbed, without changing their structure, and remaining quite homogeneous. The amount of water in vivianite crystals is also variable; the latter depends on the formation of solid solutions of water, and is very common among numerous classes of chemical compounds.

The Imperial Entomological Conference.

THE second Imperial Entomological Conference, which was summoned by the Secretary of State for the Colonies at the instance of the Imperial Bureau of Entomology, was held in London on June 9-18, and was attended by twenty-one delegates, representing the governments of most of the British Dominions and Colonies. The delegates were received by Earl Buxton, chairman of the Committee of Management of the Bureau, at Burlington House, where the meetings were held. They were also invited to a reception at the British Museum (Natural History) and to meetings of the Zoological and Linnean Societies, and were given the opportunity of visiting Oxford and Cambridge, and the Rothamsted Experiment Station and the Ministry of Agriculture's Pathological Laboratory at Harpenden.

The public meetings of the Conference occupied four days, one of which was largely devoted to the general aspects of applied entomology. Dr. G. A. K. Marshall, Director of the Bureau, read a paper on "The Aims and Organisation of Economic Entomology." After briefly reviewing the steadily increasing importance of tropical agriculture as a source of the world's food supply and raw materials, he said that the economic effect of insect pests is not fully realised. The suggestion sometimes made that crops that suffer severely from pests in a given country should be abandoned in favour of others is not feasible in the case of essential crops, and as the world's population increases, it will become more and more necessary to protect them from insect pests.

The present organisation of economic entomology is unsatisfactory. Economic entomology should be preventive, but a government entomologist, responsible for a huge area of country, cannot hope to do more than wait to be called in by planters for advice, which only happens when an outbreak of a pest is well under way, and its control has become difficult, not impossible. What is required is that the planters should themselves employ their own entomologists, who would be continually working on the problems of their special crops, and would take steps to prevent outbreaks of pests from arising. This would effect an enormous saving, and should be regarded as a form of insurance. The Hawaiian Sugar Planters' Association affords an excellent example of how a scheme of this sort should be put into practice. The government entomologists would then be free to undertake research.

Dr. T. W. Munro gave an account of the organisation of forest entomology in England, and in the discussion that followed, the various systems of economic entomology at home and in a number of the Dominions and Colonies were described. A point strongly emphasised here, and also at the other meetings, was the diversity of problems presented, not only by the obvious differences of climate, crops and pests, but also by the great differences in the populations concerned. Thus in Egypt, where agriculture is chiefly in the hands of the illiterate classes, measures against insect pests are not only organised, but also actually carried out, with excellent results, compulsorily by the government, the growers paying the bulk of the cost; whereas, at the other end of the scale, in South Africa all that is necessary is for one of the more progressive men in a district to be shown what to do, the others being only too glad to imitate his work.

In discussing the qualifications of an economic entomologist, Mr. H. H. King pointed out that he must not only have had the necessary scientific training, but must also have personality and a knowledge of men, so as to be able to convince those with whom he has to deal that they would benefit by carrying out the measures he suggested.

Several of the meetings were devoted to pests of particular crops and other aspects of economic entomology in the various colonies, and a great deal of valuable information was interchanged; but they were, of course, of rather specialised interest. Perhaps the most important discussion of the meetings, however, particularly in view of the reports of the East Africa Commission and of the League of Nations Conference on the subject (NATURE, June 27, p. 985), was "Co-ordination of Effort in Tsetse-fly Investigations." The chair at this meeting was taken by Mr. W. Ormsby Gore, Under-Secretary of State for the Colonies. In opening the discussion, Prof. Warrington Yorke said that the problem is not purely entomological, but comprises four factors, namely, the trypanosomes concerned, the population and domestic stock, the transmitting agent or tsetse-fly, and the reservoir of the virus, or big game. An advance can only be made by taking into consideration at the same time and in the same locality all these factors. In short, he advocated centralisation of effort. Much of the scattered work at present being carried out is failing to produce satisfactory results owing to its being misdirected, to lack of continuity and to lack of funds. He thought, however, that the International Commission suggested by the Sleeping Sickness Conference that met in May under the auspices of the League of Nations was premature, and that knowledge is not yet sufficiently advanced for regulations to be formulated governing the international frontiers of tropical Africa. More is to be hoped for from an inter-colonial conference, by means of which the work of entomological, medical and veterinary research could be combined under one central organisation, supported by pooled contributions of all the colonies interested.

Mr. C. F. M. Swynnerton agreed that co-ordination between the different branches of science was very necessary, but considered that a central organisation would meet with almost insuperable difficulties. He pointed out that there are twenty species of tsetse-fly, each having its own requirements in the matter of habitat and possibly fauna, and also occurring in a variety of combinations. There are thus probably fifty different tsetse-problems in different parts of Africa. Each colony should have its own department for the subject; touch should be maintained between the colonies by mutual visits and, if possible, by a travelling director who should go from colony to colony. He described the work in Tanganyika Territory, an account of which has already been given in NATURE of March 7, p. 338, and showed how co-operation has been obtained not only among the various scientific departments, but also with the natives themselves. International and inter-colonial co-operation must be provided for, as the problems are often the same on different sides of political boundaries. He does not consider measures against game justifiable in the present state of knowledge; and even if they proved to be so, they would be very difficult in practice. He gave instances of cases in which they have actually defeated their own object.

Dr. A. Balfour agreed with the need for inter-colonial co-operation, but considered that, as the problems in the east and west of Africa are so different, and intercommunication so difficult, it might be better to have two organisations instead of the single one suggested by Prof. Yorke.

Major E. E. Austen objected to Prof. Yorke's unqualified statement that game is the reservoir of sleeping sickness. He supported the idea of an International Commission, for, in the special problems to be dealt with, political boundaries are often not natural ones. He emphasised the multiplicity of the problems presented by the various species of tsetse-fly and the consequent need for attacking them by every feasible method. Dr. A. G. Bagshawe pointed out that it is only within the last two years that we have been shown by Mr. Swynnerton that valuable land can actually be recovered from the fly. All efforts should be concentrated on making this work a success on a larger scale. Dr. G. A. K. Marshall observed that trypanosomiasis has to be dealt with on two main lines: the attack upon the disease, and the attack on the flies. A single comprehensive investigation in one place may be excellent on the medical side, but on the entomological side there are numerous problems that can only be solved by investigations in many different localities. While on the medical side further extensive research is the primary need, this is not the case on the entomological side, at least in those countries where the advance of the flies constitutes a dangerous menace. Here the primary need is for an immediate direct attack upon the flies by methods similar to those so successfully employed by Mr. Swynnerton, accompanied by appropriate research. One great difficulty in the past has been procuring the necessary funds; and the reclamation of valuable land by a direct attack on the fly is more likely to appeal to the governments and commercial interests concerned than any programme of purely scientific research.

The chairman supported the idea of an International Commission as proposed by the League of Nations Conference, not only from the scientific point of view, but also from that of educating the general public and the administrators. Money is essential, and public interest must be directed to the economics of the problem. From this point of view the veterinary side is of enormous importance. A scheme that suggests the killing of big game when the smaller animals would remain is contrary to common sense, but a practical policy, such as that of Mr. Swynnerton, should obtain public support.

Before the Conference ended resolutions were passed recommending, among other things, that a similar conference should be held in London every five years; that meetings of entomologists and other scientific officers should be held in the Dominions and Colonies for the discussion of mutual problems; and that the work of the Imperial Bureau of Entomology should continue on the present lines and be somewhat extended in connexion with the export to Oversea Governments of beneficial parasites.

The Conference concluded with a dinner given by the Government in honour of the delegates, at which Mr. L. C. M. S. Amery, Secretary of State for the Colonies, presided.

Photographic Studies of Solar Prominences.[1]

THE invention of the spectroheliograph, more than thirty years ago, made it possible to study in detail photographs of the prominences, those strange and beautiful forms rising from the chromosphere which were first made familiar to readers of NATURE by the drawings of Lockyer in the 'seventies. Systematic photographic work does not appear to have been initiated until it was taken up at Kodaikanal in 1905, and the Rumford spectroheliograph appears also to have begun recording prominences at about this period; but until recent years very little has been published regarding their movements. This is no doubt largely due to difficulties imposed by atmospheric conditions, for it is very rarely possible to secure a series of photographs of the same prominence at short intervals of time and with equally good definition in all the images. In the memoir under notice this is apparent in the statement that in about 4000 plates examined "very little material suitable for the study of the motions of prominences was found." We must congratulate Mr. Pettit on the very interesting results he has nevertheless extracted.

The work relates very largely to the eruptive prominences, which are defined as "those which rise from the chromosphere in a more or less vertical direction, and are dissipated in space at enormous altitudes." It had already been shown by observers of eruptions that the velocity of ascent increases with the height, and photographs of prominences of this class obtained at Kodaikanal and in Kashmir appeared to show a continuously accelerating velocity, indicating a force of repulsion from the sun, analogous to that which gives an accelerating velocity to the gases in comets' tails. The author, however, from a careful study of the great prominence of May 29, 1919, considers that the force in this case was discontinuous, the outward velocity increasing by a series of sudden impulses, between which the motion was uniform. Other prominences observed later also displayed this very remarkable characteristic, and Mr. Pettit was led to examine all recorded observations of eruptive prominences, visual and photographic. The results are set out in 24 diagrams, giving the heights as ordinates and times as abscissæ. The evidence as thus presented appears strongly favourable to the principle of uniform motion and sudden impulses; for many of the diagrams indicate this very clearly, although others, *e.g.* No. 22, would seem to indicate a continuous acceleration. Of three cases which come within the knowledge of the writer of this notice, two decidedly favour continuous acceleration. These are numbered 8 and 9 in Fig. 3. In No. 8 there is an error in the height given at 9 h., which should be 110,000 instead of 130,000 km. By substituting this height in the diagram, it appears that a continuous curve would better fit the observations than that shown. In the case of the prominence of May 26, 1916 (Fig. 3, No. 9), measures of the negatives published in Kodaikanal Observatory Bulletins III., 215, are not used in the plot, but instead a set of measures from half-tone prints. Had the original measures been used, a continuous curve would have resulted. Evidence in favour of uniform motion is admitted in the case of No. 24, which was photographed at Kodaikanal, but here the time interval is short, and no change of velocity is indicated from three observations of the height.

Obviously this question of the character of the motion is of the greatest interest and significance, and it will no doubt be exhaustively studied in future eruptions.

The material supplied by the Rumford spectroheliograph has enabled Mr. Pettit to study successfully both lateral and internal motions of prominences. Lateral motions are defined as "the motions of prominences which rise from the sun's surface, and, passing over a trajectory, generally re-enter the chromosphere." A very curious example is recorded

[1] "The Forms and Motions of the Solar Prominences." By Edison Pettit. Publications of the Yerkes Observatory, vol. 3, part 4. University of Chicago Press.

in which this trajectory appears as a circle of radius 73,500 km., and the motion along the circumference increases from 5 to 95 km./sec.

The tendency of prominences to form long horizontal streamers connecting one with another, or curving down towards the chromosphere, is familiar to all who have observed these objects. Mr. Pettit has found that motion takes place along these narrow filaments, which represent, therefore, stream-lines of luminous gas, and these lines often appear to converge towards "centres of attraction" in the chromosphere. The large prominence of May 29, 1919, afforded rich

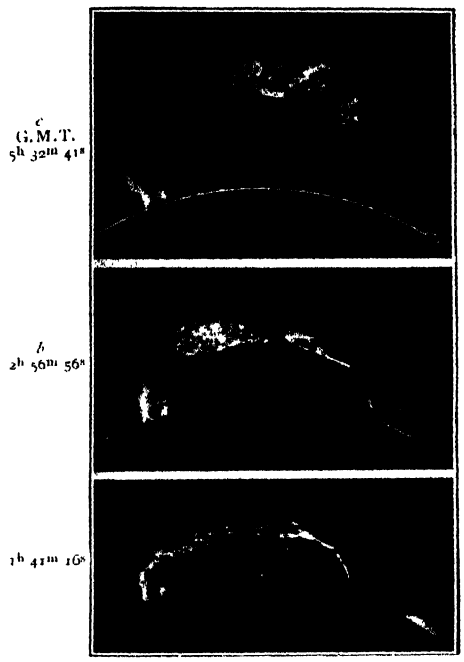

FIG. 1.—The great prominence of May 29, 1919
Scale: a, 1 mm. = 18,652 km.; b and c, 1 mm. = 16,842 km.
From "The Forms and Motions of the Solar Prominences."

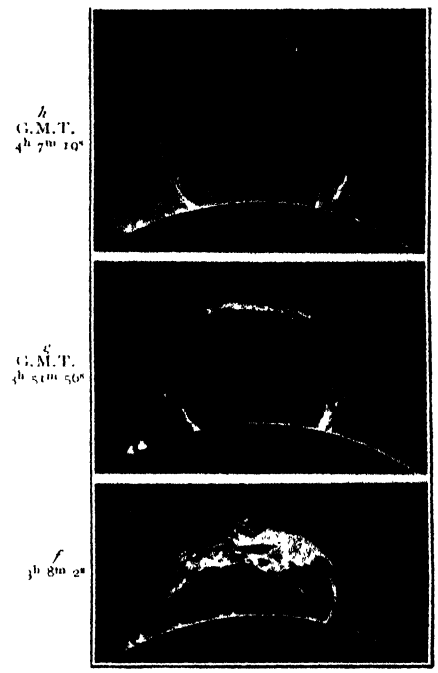

FIG. 2.—The prominence of July 15, 1919.
Scale: 1 mm. = 19,144 km.
From "The Forms and Motions of the Solar Prominences."

naterials for a detailed study of these movements. ie of the illustrations is here reproduced (Fig. 1).

As regards the supposed attraction of sunspots for ominences, Mr. Pettit finds many examples of knots streamers, or the streamers themselves, moving nwards towards a spot-region, and a few in the reverse irection. Previous observations at Kodaikanal howed a predominance of outward movements.[1] hat these filaments or knots actually enter the mbræ of spots remains uncertain, and no case is ecorded of an entire prominence being thus swallowed up. The streamers of the great prominence of May 1919, although they converge towards a sunspot, would appear to fall short of it by about 4° of latitude (Fig. 7), and at a later stage (Fig. 8) they seem to be repelled from the spot. Other "centres of attraction" for prominence streamers are shown to exist in regions remote from spots, and there is evidence that this attraction is felt far out into the coronal region.

The question whether gravity plays a part in the descent of matter in the streamers is investigated, and it is found that, in general, velocities are in the neighbourhood of one-third to one-fourth of that which gravity ought to give them. The velocity of ascent in the eruptive prominences seldom exceeds 400 km./sec., although line-displacements have been recorded which indicate much higher speeds.

The memoir concludes with a theoretical discussion of the nature of the repulsive force acting on prominences. Radiation pressure is rejected as inadequate, and the periodic ejection of showers of electrons from a disturbed area in the photosphere is suggested tentatively.

J. EVERSHED.

[1] Monthly Notices of the Royal Astronomical Society, 73, 422.

Industrial Fatigue.

THE fifth annual Report of the Industrial Fatigue Research Board (H.M. Stationery Office, Price 5s. 9d.) has recently been issued. Its contents are nearly equally divided between six articles contributed by the Board's principal investigators and the part proper describing the Board's activities during 1924. Perhaps the most striking development in the period has been in the direction of the increasing laboratory research work, now conducted for the Board in the Universities of Oxford, Cambridge, London, Glasgow, and Manchester, and concerned with accuracy of movement, muscular skill, repetitive work, weight-carrying, dynamic and static muscular effort, rest pauses, etc. The human factors relevant to accident causation, ventilation, illumination, and the like are also being studied. Research into vocational guidance has been undertaken in collaboration with the National Institute of Industrial Psychology, and into the design of machinery in conjunction with the Department of Scientific and Industrial Research. Three reports of specific investigations were published by the Board during 1924,

dealing with rest pauses, repetitive work, and posture; and two other reports have been issued, one presenting a synopsis of the results of the Board's previous investigations in various industries, and the other describing the uses and limitations of statistical methods in such research.

Those who are unacquainted with these and with the twenty-four earlier reports of the Board will obtain an excellent idea of the Board's invaluable work by a study of this annual report. The special contributions by Mr. Wyatt, Miss May Smith, Mr. Farmer, Miss Newbold, Dr. Vernon, and Mr. Weston concern learning curves in industry, exceptional work curves, differential tests in relation to proneness to accidents, sickness statistics, the significance of output, and the value of personal evidence in the investigation of industrial efficiency. These well illustrate the various problems and difficulties with which the Board is confronted. The numerous investigations and committees of the Board, and the extremely interesting and lucid language of the annual report, bear testimony to the devotion, ability, and organising power of its secretary, Mr. D. R. Wilson.

The survey, with which the Report concludes, of the past activities and of the present position of the Board is especially noteworthy. Stress is there laid on the fact that such indications "as emerge from the investigations undertaken by the Board and the National Institute of Industrial Psychology are surely worthy of serious attention on the part of industry, if only for the reason that, from the very method of their assessment, strong evidence exists that they will benefit the employer no less than the workman." It is surely lamentable, then, to read on pp. 16 and 17 of the Report that the Jute Spinners and Manufacturers' Association recently declined "to participate in any inquiry or even to afford facilities for a preliminary survey" by the Board in that industry, although the Board had been expressly invited by the Jute Trade Board to undertake an investigation into the effects of fatigue, and the workers desired that it should be carried out.

Rothamsted Experimental Station.

OPENING OF THE PLANT-PATHOLOGY LABORATORIES.

THE annual meeting of the subscribers to the Society for extending the Rothamsted Experiments was held on Thursday, June 18, when at the invitation of Lord Clinton, chairman of the Lawes Agricultural Trust, about sixty members and visitors attended.

In the morning the experimental fields were inspected. As for some years past the total number of plots has exceeded 500, it is usual to select for the annual inspection a limited set illustrating one or two special points. On the present occasion a series was chosen to illustrate certain contrasts between modern and early methods of planning field experiments. Lawes' and Gilbert's early field experiments were laid out on the parallel strip system, the best known example being the classical Broadbalk field which has grown wheat every year since 1843. The strip system was simple and straightforward, and adequately showed up the large differences in yield between the various manurial dressings, especially when the experiment was repeated over a large number of years to eliminate the variable effect of season. The next stage was the "chess-board" plan in which the parallel strips of plots receiving different manures were crossed at right angles by strips of other manures. This method was adopted in the Hoos field permanent barley experiments commenced in 1852, and the arrangement permits of a greater number of comparisons between given manures, alone, and in various combinations.

Many of the broad generalisations, now an integral part of farming practice, were developed from the Broadbalk and Hoos experiments. These two fields are still giving exceedingly valuable information, but they are not suitably arranged to provide definite answers to many modern problems, in the majority of which the maximum difference expected between control and treated plots is a few bushels of corn or hundredweights of roots. It therefore becomes essential to reduce the experimental error as much as possible. The first step is to have a considerable number of small plots under each treatment, and to harvest each plot separately. Further, in order to allow for the inherent variation of fertility in the land, the results are examined by statistical methods devised specially for this purpose. It is an essential condition of such an examination that the plots should be distributed not systematically but at random. From the viewpoint of visitors this complicated system is perhaps not so striking as the older plots, but it has the great advantage of giving a reasonably accurate result in a fairly short period of time. As an illustration of the method, the visitors were shown the experiments on the effect of varying the amount and time of application of nitrogenous top-dressings to the oat crop.

After lunch, Lord Clinton in a short address referred to the close touch now maintained between agricultural research institutes and modern farming problems, and to the facilities for the fundamental study of plant diseases now available at Rothamsted. Sir John Russell then gave a brief account of the type of problem that would be investigated in the new laboratories, and also directed attention to the economic importance of such work.

Lord Bledisloe expressed his pleasure at being invited to perform the opening ceremony of the new plant-pathology laboratories, because they were erected during the period when he was chairman of the Lawes Trust. In reviewing the history of the Station, he was impressed by the rapid application to farm practice of the results obtained by Lawes and Gilbert. As a result the wheat production increased in twelve years from an average of 22 bushels to 32 bushels per acre. He was further impressed by the loss sustained by farmers due to pests of various kinds attacking the crops. Although it was not easy to arrive at an accurate estimate of such losses, the most reliable figures put it at no less than 10 per cent. of the total value of crops in Great Britain. It was evident that the Ministry of Agriculture, in defraying the cost of erection and equipment of the extensive new plant-pathology laboratories at Rothamsted, were alive to the importance of research work in plant diseases. He had great hopes that effective preventive and remedial measures would soon be developed as a result of the facilities now provided.

At the conclusion of the address Sir Thomas Middleton moved a hearty vote of thanks to Lord Bledisloe, who afterwards unlocked the door of the new building. Members of the entomological and mycological departments then conducted the visitors around the laboratories. In addition to a range of research laboratories, there are a number of rooms for special operations, such as pure culture and constant temperature work, and a separate building fitted up for use as an insectory.

University and Educational Intelligence.

CAMBRIDGE.—The Harkness Scholarship for geology is awarded to A. J. Galloway, King's College; the Frank Smart Prizes are awarded to A. R. Clapham, Downing College, for botany, and to G. E. Hutchinson, Emmanuel College, for zoology; the Wiltshire Prize for geology is awarded to M. Black, Trinity College.

Sir David Lionel Goldsmid-Stern-Salomons, Bart., has left by his will 5000*l.* to Gonville and Caius College for the fund for increasing the College buildings, and 1000*l.* to augment the Salomons Engineering Scholarship Fund. He has left to the University all his scientific instruments and medical apparatus, all models and human specimens suitable for instruction, his collection of crystals and other apparatus used for polariscope work. The Broomhill magnet and the apparatus with it is bequeathed to the Royal Institution, London.

ST. ANDREWS.—The honorary degree of LL.D. has been conferred upon Prof. F. G. Donnan, professor of inorganic and physical chemistry in the University of London, and upon Mr. R. T. Gunther, fellow of Magdalen College, Oxford.

THE Medical Research Council has awarded Rockefeller Medical Fellowships, tenable in the United States of America during the academic year 1925–1926, to the following: Dr. D. Campbell, Pollok lecturer in pharmacology and therapeutics, University of Glasgow; Mr. W. H. Craib, house physician, Guy's Hospital, London; Dr. Katherine H. Coward, assistant in biochemistry, University College, London; Mr. W. S. Dawson, senior assistant, Maudsley Hospital, London; Mr. H. W. Florey, John Lucas Walker Student, University of Cambridge; Mr. A. D. Ritchie, lecturer in physiological chemistry, University of Manchester; Mr. G. P. Wright, Macgregor Student and demonstrator in histology, University College, London. Dr. Craib, Mr. Florey and Mr. Ritchie have been appointed on modified conditions while holding scholarships or emoluments from other sources. Mr. Ritchie's fellowship is being held during a short period of work in Canada this summer.

FISCAL support of State universities and State colleges is discussed in great detail in Bulletin, 1924, No. 28 of the United States Bureau of Education. There is great variation as between the different institutions in the ratio between student fees and State appropriations. In 1921 the University of Texas received eleven dollars through State appropriations for every dollar received from student fees, while at the University of Wisconsin the ratio was 2¼ to 1. The line between free public higher education and payment of part of the cost by the student has been generally lowered during the past twenty years from the beginning of the professional courses to the beginning of the undergraduate courses, and the tendency of fees for both academic and general and professional courses is to increase. The writer of the bulletin assumes that the State universities will profit much from gifts of alumni for special purposes as they become older, but it does not now appear that they can hope to meet a large part of their operating expenses from endowments, the brunt of which will continue to fall on the State and the students.

ERRATUM.—The name P. R. Cuvati in the issue of June 27, p. 997, col. 1, line 6, should be P. R. Awati.

Early Science at Oxford.

July 6, 1686. Some of ye Society gave an account that about noon that day, they saw *Venus* near ye Moon without ye help of a Telescope, when the Sun shone very clearly, and that many people in ye streets observed ye same thing.

Then was read a specimen writ by Mr. John Adams (who has allready spent diverse years in a general Survey of England) concerning the *description* of particular *parishes*, who desired ye opinion and advice of ye Society what therin may be fit to pursue, what to omit of it, or what other remarks to adde.

July 8, 1684. An account of ye weather at Dublin, in May last, taken, in a scheme according to Dr. Lister's Method, by Mr. Molineux, was presented by him to this Society Ordered, that ye thankes of this Society be returned to Mr. Molineux for this Obligation A Letter from Mr. Maunders, dated July 2, and giving an account of ye very great damage, lately done, to some parts of Somersetshire, by caterpillars, was read.

An account of a monstrous child, born, not long since in Jutland, with 2 draughts of that Child were presented.

Two letters written, some years since, by Mr. Lister, to Dr. Oldenbourgh were read: one concerning ye great age of severall persons in Craven; ye other concerning ye projection of ye threds of Spiders, and of bees breeding in cases made of leaves; as also concerning a viviperous flye. Mr. Todd promises an account of ye most aged persons in Cumberland; and Mr. Crouch, at ye request of ye Society, engages to examine ye Register which gives an account of Mother George's age.

A Paper was presented, containing ye design of some learned Gentlemen in Somersetshire, to write ye naturall, civil, and ecclesiasticall History of that County.

July 13, 1686. In a letter to Mr. President, Mr. Halley promises to send an extract of ye Journal of ye Royal Society for ye time we want it, and for ye future to send us once a fortnight what shall occur there. In a second letter he gives an account that ye Royal Society will allow him £50 to measure a *degree* of ye earth, and that he intends to take ye latitudes with an instrument of 20 foot radius, with telescopic sights. He adds that he has seen a Calico shirt brought from India which is *woven* without a seam all of one peice.

July 14, 1685. After some interruption of our meetings by reason of ye Rebellion, on this day, (Dr. Smith being in ye Chair), three letters from Mr. Aston were read.—The ways of making Prince's metall mention'd in ye letter of July 2 were ordered to be tryed, which Mr. Ballard undertook to do.

Mr. St. George Ash, Secretary of the Dublin Society, sent ye Minutes of that Society for ye month of June: together with a paper enclosed in it, drawn up by Mr. Smith, Fellow of Trinity College, by way of answer to Mr. Molyneux's Quæries concerning Lough-Neagh, which paper with very good reason ascribes a petrifying quality to ye Earth, but not to ye Water of that Lough. The thankes of this Society were ordered to Mr. Ash and Mr. Smith for these communications.—Mr. Aland's discourse concerning ye longitude, and an account of ye monstrous fish mentioned in ye Dublin Minutes, are desired to be sent us.

Dr. Cony presented ye Society with a telescope in ye name of Thomas Hardresse of Rochester Esqr. Ordered that ye Secretary send ye most humble thankes of this Society to Mr. Hardresse for this very generous present, and that it be carefully preserved in their Repository.

Societies and Academies.

LONDON.

Royal Society, June 25.—D. H. **Black**: β ray spectra of thorium disintegration products. Using comparatively strong sources of thorium-B in equilibrium with thorium-C and thorium-D, the β ray spectra of these substances have been re-measured in order to bring them into line with the standard spectrum of radium-B. Several new lines were found. Of these, one group is of great interest on account of the fact that, despite their high energy (2·5 million volts), they are due to the expulsion of electrons from the K, L, and M levels of an atom by one γ ray.—C. F. **Elam**: Tensile tests of crystals of an aluminium zinc alloy. The crystals, containing 18·6 per cent. zinc, resemble pure aluminium in structure and contain the zinc in "solid solution." They are harder and less ductile than pure aluminium. Fracture occurs on one or more planes at approximately 45° to the axis. These planes are closely related to crystallographic planes. Slip planes are sometimes parallel to planes of fracture.—G. **Shearer**: On the distribution of intensity in the X-ray spectra of certain long-chain organic compounds. In the X-ray "spectra" of substances the molecules of which contain long open chains of carbon atoms, there is a certain large spacing corresponding to planes at distances apart closely related to the length of a single molecule or of two, end to end. A large number of successive orders of reflection from this plane can be observed, and their distribution of intensity is calculated on certain simple assumptions as to the distribution of scattering material along the length of the molecule. It is thus possible to fix with reasonable accuracy the position in the chain of the CO group in such series as the ketones and the esters; this appears to open up a new application of X-ray methods to chemical analysis. Further work on these lines may throw light on the relative scattering power of the various atoms and atomic groups.—C. F. **Jenkin**: High-frequency fatigue tests. High-frequency fatigue tests on copper, Armco iron, and mild steel were obtained at frequencies so high as 2000 periods per second, and unsuccessful experiments were made up to 5000 periods per second. There is a small rise in the fatigue limit as the speed is increased. The dependence of the fatigue limit on the frequency has, however, an important bearing on the theory of fatigue failure. The term "fatigue limit" is used here to denote the greatest alternating stress which can be applied to a material for an indefinitely large number of periods without causing fracture.—L. W. **Bryant** and D. H. **Williams**: An investigation of the flow of air around an aerofoil of infinite span. The stream-lines deduced were compared with those for inviscid flow obtained by means of an electric tank in which the equipotential lines were equivalent to stream-lines in a perfect fluid. Except for a narrow trailing "wake," the lines of viscous flow approximate to those for an inviscid fluid, when a circulation equal to that experimentally determined in the wind tunnel is superposed upon the flow around the aerofoil without circulation. The boundary layer around the nose and over the under surface of the aerofoil is very thin. Velocities deduced from observed pressures on the surface agree very well with velocities measured in the free stream, except over the upper surface, where "wake" begins to develop.—G. I. **Taylor**: Note on the connexion between the lift of an aerofoil in a wind and the circulation round it (Appendix to preceding paper). The connexion between the lift force on an aerofoil and the circulation round it is independent of the contour chosen if the flow is irrotational, and also if the flow is not irrotational provided that a special type of contour is used, according to Messrs. Bryant and Williams. Their contours happen to be of the special type, so the accuracy with which the observed lift force agrees with that predicted from measurements of circulation is no indication that the flow is in fact an irrotational motion with circulation.—T. H. **Havelock**: Wave resistance: the effect of varying draught. The effect of finite draught is considered; in particular, calculations are made when the ratio of draught to length is one-twentieth and one-tenth, a range which covers approximately ship models. The theoretical curves show a reasonable agreement with experimental results.—C. V. **Raman** and L. A. **Ramdas**: The scattering of light by liquid boundaries and its relation to surface tension. Part III.—W. H. **George**: An electrical method for the study of impact applied to the struck string. The two impinging bodies close, during the impact, a simple electrical circuit which includes an oscillograph. From the current variations shown in the oscillograph record, the variations in mechanical pressure during the impact is derived. With a struck string there are important fluctuations in the pressure between the hammer and string, depending markedly upon the position of the striking point along the string. At some places there is a momentary complete separation of hammer and string. These results are inconsistent with the older theories of the struck string, but are consistent with the newer theories. The ballistic galvanometer method to determine the duration of the impact upon the struck string is, in general, invalid.—F. H. **Constable**: The mechanism of catalytic decomposition. A quantitative theory based upon the series of papers entitled "The Catalytic Action of Copper" (Proc. Roy. Soc., A, vols. 98 to 107) is developed. The dehydrogenation of alcoholic substances by copper occurs in stages. Reaction only occurs in a unimolecular layer in which the $-CH_2OH$ groups are in contact with the copper surface. Activation of the alcohol molecule by the catalyst consists in increasing the distance between the H atom and the O atom in the hydroxyl group. Quantitative treatment from this point of view leads to results which are not in accord with experiment. Application of the theory of probability to the conception of a "reaction centre" enables the number of centres present to be connected with the heat of activation of each by an exponential relation. The equation obtained is in accord with experience in so far as it can be tested.—S. A. **Emerson** and L. C. **Martin**: The photometric matching field.—H. Peripheral stimulation of the retina with white light may cause a reduction in the limen of contrast perception at the fovea. With monochromatic lights, using the same wave-length in centre and surround, initial reductions followed by a rise in the limen are found with increasing brightness of surround at all wave-lengths, but the reductions are small in the red as compared with the blue end of the spectrum. The effects may be partly due to reflex actions associated with the retinal rods.—G. S. **Adair**: Partial osmotic pressures and membrane equilibria. Methods for calculating partial pressures are described, based on a long unrecognised equation for membrane equilibrium, developed by Gibbs. The modified form of Dalton's law applies to certain hæmoglobin solutions over a wide range of concentrations, not necessarily restricted to the very short range where the pressure is proportional to the concentration. The partial

osmotic pressure of hæmoglobin is relat d to the concentration by a form of Van der Waals' equation.—**Mary W. Porter**: A contribution to the study of the optical properties of mixed crystals. In mixtures of ammonium- and rubidium-magnesium chromates: (1) Variation of principal refractive index for vibrations along the symmetry axis is directly proportional to composition as expressed in volume or molecular percentage. (2) The other two principal indices are also continuous functions of the composition, but are not directly proportional. The general result extends the work of Lavenir and Dufet on orthorhombic mixtures.—H. **Gregory** and C. T. **Archer**: Experimental determination of the thermal conductivities of gases.—D. B. **Deodhar**: On atmospheric radio-activity and Indian weather.—J. R. **Partington** and A. B. **Howe**: The ratio of the specific heats of hydrogen. The determination of the ratio of the specific heats of hydrogen was undertaken by a method of adiabatic expansion previously used with air and carbon dioxide. The mean of nine determinations with pure hydrogen at atmospheric pressure and temperature gave γ $C_p/C_v = 1{\cdot}4113$, and the values of C_v (4·832 gm. cal.) and C_p (6·820 gm. cal.) were calculated from this value and $C_p - C_v = 1{\cdot}9875$.—A. **Cary** and E. K. **Rideal**: The behaviour of crystals and lenses of fats on the surface of water.—Part I. In the process of "surface spreading," on water and solutions of N/100 hydrochloric acid, of organic compounds containing a long chain terminating in a polar group, unimolecular films spread from crystals as well as lenses, a definite equilibrium surface tension or two-dimensional pressure, characteristic of the compound in question, being established. Spreading oil films appear to be pushed out from the source (lens or crystal) by the further entry of molecules into the surface layer, rather than pulled out over a surface by the attraction of the uncontaminated water.—G. H. **Henderson**: The capture and loss of electrons by α particles. Singly charged α particles were measured by an ionisation method. The ratio of doubly charged to singly charged particles in equilibrium is the same in different materials, such as gold, mica, aluminium, etc. With this ratio for any material expressed as the nth power of the velocity, the value of n increased as the velocity decreased.—A. S. **Parkes**: The effects on fertility and the sex-ratio of sub-sterility exposures to X-rays.—R. N. **Chrystal**: The genus Dreyfusia (order Hemiptera, family Chermesidæ) in Britain and its relation to the silver fir.—T. **Moran**: The effect of low temperatures on hens' eggs.—T. C. **Angus**: The electrical characteristics of an arc lamp (direct current) measured by biological effect.—R. J. **Lythgoe** and J. R. **Pereira**: Muscular exercise, lactic acid, and the supply and utilisation of oxygen.—Part XI. Pulse rate and oxygen intake during the early stages of recovery from severe exercise.—J. R. **Pereira**. Muscular exercise, lactic acid, and the supply and utilisation of oxygen.—Part XII. A note on the technique of determining the resting oxygen intake while breathing concentrated oxygen mixtures.—Mary E. **Laing**: The composition of soap films.—G. R. **Goldsbrough**: Torsional vibrations in reciprocating engine shafts.—D. **Brunt**: Periodicities in European weather.—S. **Barratt**: The absorption spectra of mixed metallic vapours (II.).—S. R. **Savur**: On the stress-optical effect in permanently overstrained celluloid.—O. W. **Richardson**: Structure in the secondary hydrogen spectrum (II.).—A. **Cary** and E. K. **Rideal**: The behaviour of crystals and lenses of fats on the surface of water (II. and III.).—J. E. **Jones** and P. A. **Taylor**: Some theoretical calculations of the physical properties of certain crystals.—C. **Chree**: The relationship between the "solar constant" and terrestrial magnetism.—J. A. **Carroll**: The vacuum spark spectra of some of the heavier elements and series classification in the spectra of ionised atoms homologous with copper, silver, and gold.—Sir J. C. **Bose**: Physiological and anatomical investigation of *Mimosa pudica*.—J. F. **Fulton**: Fatigue and pluri-segmental innervation of individual muscle fibres.—G. **Matthai**. Colony formation in astræid corals (I).

Royal Anthropological Institute, May 19.—R. Ruggles **Gates**: Mendelian inheritance in man. Many abnormalities in man are inherited as simple Mendelian differences, and this is to be expected, since they must have arisen as single mutations. Such are brachydactyly and many other digital abnormalities, which are usually inherited as dominant characters. There is evidence that even slight abnormalities may sometimes be lethal in their effects when present in the homozygous condition. Cataract is usually inherited as a dominant, while such conditions as albinism and alkaptonuria are recessives. Colour-blindness, hæmophilia and some other conditions are usually sex-linked in inheritance, their history following exactly the course from generation to generation taken by the sex chromosomes. But various exceptions are found; and the same character may be differently inherited in different families, according to which part of the germ plasm was originally altered. The cephalic index has long been regarded as an important racial character. Recent investigations of Frets, Hildén, and others lead to the view that multiple, cumulative size factors are involved and that brachycephaly in general is dominant over dolichocephaly. Age, sex, nutrition, stature and climate affect the head form. Interracial crosses appear frequently to give 2-peaked curves for cephalic index in later generations. Records of crosses between Indians and whites, obtained in Northern Ontario, indicate that skin-colour segregates and that eye-colour is inherited independently of skin-colour.

PARIS.

Academy of Sciences, June 2.—A. **Haller** and F. **Salmon-Legagneur**: The action of methyl magnesium iodide on the esters of the α-mononitrile of camphoric acid. When the reaction takes place in etherial solution the corresponding tertiary alcohol is produced; in toluene solution the nitrile group also takes part in the reaction, a ketone-alcohol being produced.—H. **Vincent**: The plurality of the toxins of the coli bacillus and the experimental bases of anticolibacillus serotherapy. Evidence is given of the existence of toxins of *B. coli communis*, differing in their thermostability and action on animals.—de **Sparre**: The velocity of propagation of the ram stroke in armoured concrete mains.—Amé **Pictet**, Werner **Scherrer** and Louis **Helfer**: The presence of argon in the gases from the alcoholic fermentation of glucose. Observations are given showing that in the alcohol fermentation of glucose, argon is evolved. It remains to be proved if this gas pre-exists in the yeast and in what form.—C. **Sauvageau**: The development of *Leathesia difformis*.—Benjamin **Jekhowsky**: The generalisation of Cauchy's numbers.—Stefan **Banach**: A characteristic property of orthogonal functions.—P. J. **Myrberg**: Discontinuous groups of linear substitutions.—C. **Dévé**: An apparatus for microscopic reduction entitled "Pangraphic." A description of a simplified pantograph, without articulation.—Bernard **Lyot**: Variations of the polarisation of Mars in the course of an

atmospheric disturbance.—Jean **Boccardi**: The rotation of the interior planets.—H. **Noirel**: Determinations of the intensity of gravity made in the Republic of Ecuador during the expedition of the Service géographique de l'Armée (1899-1906).—Mlle. E. **Gleditsch** and E. **Botolfsen**. The X-ray spectrum of praseodymium, neodidymium, and samarium. Tables are given showing the wave-lengths of seven lines for each metal.—J. **Heyrovsky**: The physical signification of electrolytic solution pressure.—Eugène **Delauney**: A new method of quantitative analysis by X rays. Various elements absorb a monochromatic bundle of X-rays to different extents. Details of the application of the method to solutions of barium and strontium chlorides, and of potassium chloride and bromide, are given.—J. L. **Costa**: The precise determination of the atomic mass of lithium 6 by Aston's method. Taking He 4·000, the mass of the lithium (6) atom was found to be 6·0101 ·002.—René **Audubert** and Henri **Rabaté**: A method of determination of the granulometric distribution of dispersed systems.—Ch. **Courtot** and R. **Geoffroy**. 2 7 0 0′-tetrahydroxy-fluorene.—R. **Lautz** and A. **Wahl**. The arylaminonaphthoquinones. The arylaminooxynaphthalene sulphonic acids.—L. **Cayeux**: The existence of diatomaceous silex in the flints of the coarse limestone in the neighbourhood of Paris. The silex consists of petrified organic residues. Remains of foraminiferæ, radiolaria, ostracods, and gasteropods were found.—J. **Orcel**: A white chlorite from Madagascar.—Fernando **Navarro**: The meteorite of Olivenza (Spain). This was seen to fall on June 19, 1924. The predominant mineral is olivine, but the meteorite is remarkable for the small proportion of nickel-iron.—Jacques de **Lapparent**: The two forms of hydrocarbons in bituminous schists.—H. **Bouygues**: The axillo-cotyledon facies of the Soissons bean.—Alfred **Labriet** and Raoul **Husson**: The principle of vocal accord, or a contribution to the elaboration of a theory of the normal emission of the singing voice, and the synthesis of the corresponding vocal mechanism.—P. **Mazé**: The influence of fluorine and iodine on the reproductive functions in rats and on the growth of the young. Experiments on the necessity of the presence of fluorine in the diet of rats to ensure reproduction.—T. **Kahn**: Active protoplasmic mass and reserve albumen.—Ch. **Richet**, jr., and R. **Monceaux**: Modifications caused by cooking in the metabolism of meat. From experiments on dogs it is concluded that the metabolism of raw meat is more perfect than that of cooked meat. In diseases of the liver it is advantageous to administer raw meat: in renal affections, however, well-cooked meat is indicated.—J. **Benoit**: Compensating hypertrophy after unilateral castration in the domestic cock.—E. **Fauré-Fremiet** and J. **Murakami**: The amæbocytes of the earth worm in the quiescent and in the active state.—H. **Hérissey**: Asperuloside, a new glucoside extracted from the wood-ruff. The new glucoside has been prepared in crystals, contains no nitrogen, and gives on hydrolysis a reducing sugar and asperuligenol.—Alphonse **Labbé**: Four generations of *Artemia arietina*.—MM. **Mouriquand, Leulier, Michel, and Idrac**. C. avitaminosis and cholesterinæmia.—Raoul **Bayeux**: Structural modifications of the lung under the influence of great barometric decompressions. The essential primitive lesion of the lung determined by a sudden fall in the atmospheric pressure is the parietal hypertrophy of the alveolæ; all the cardio-vascular phenomena are secondary to this initial lesion.—F. **Henrijean**: The signification of the electrocardiogram.

Official Publications Received.

Falmouth Observatory. Meteorological Notes and Tables for the Year 1924. By Joshua Bath Phillips. Pp. 10. (Falmouth.)

The University of Leeds: Department of Coal Gas and Fuel Industries (with Metallurgy). Report of the Livesey Professor for the Session 1923-1924. Pp. 11. (Leeds.)

Mitteilungen der Naturforschenden Gesellschaft in Bern. Aus dem Jahre 1923. Pp. lxxviii+195. Aus dem Jahre 1924. Pp. lxii+166. (Bern: K. J. Wyss Erben.)

Proceedings of the Edinburgh Mathematical Society. Vol. 43 (Session 1924-25). Part 1. Edited by Dr. T. M. MacRobert and Prof. H. W. Turnbull. Pp. iii+84. (London: G. Bell and Sons, Ltd.) 5s. net.

Diary of Societies.

SATURDAY, JULY 4.

INTERNATIONAL CONGRESS OF RADIOLOGY (at Central Hall, Westminster), at 10 A.M.

BRITISH MYCOLOGICAL SOCIETY (Phytopathological Excursion to Cambridge).—Prof. Sir. R. H. Biffen and F. L. Engledow: The Inheritance of Disease Resistance.—F. T. Brooks and W. C. Moore: Silver-leaf Disease.—N. J. G. Smith: Helminthosporium Disease of Cereals.—D. Weston: The Control of Bunt in Wheat.—R. C. Woodward: Apple Mildew.—Mrs. M. N. Kidd: Fungal Invasion in Apples in Relation to Senescence. S. M. Wadham: Clover Rot.—A. Smith: Perennial Rust Mycelia.—Prof. Nuttall, Dr. Hare, and Mr. Tait: Fungi Pathogenic to Man.

PHYSICAL SOCIETY OF LONDON (at Oxford).

PHYSIOLOGICAL SOCIETY (at Oxford).

MONDAY, JULY 6.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—G. L. Purser: The Alimentary and Respiratory Systems of *Calamoichthys calabaricus*, Smith.—W. J. M. Menzies: Salmon (*Salmo salar*) of the River Moisie, Eastern Canada.—Dr. W. W. Taylor: Precipitation of Soils by Polyvalent Ions.—J. A. Warren and W. A. Tait: Analysis of Rainfall Records in Glendevon Catchment Area during the years 1914-1920.—Prof. A. A. Lawson: A Contribution to the Life-History of Bowenia.—Dr. E. Neaverson: Ammonites from the Upper Kimmeridge Clay.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

FARADAY SOCIETY (Annual General Meeting) (at Chemical Society), at 5.15. At 5.30.—A. L. Marshall: The Electrodeposition of Zinc from Acid Zinc Sulphate Solutions.—F. L. Usher: The Nature of the Interfacial Layer between an Aqueous and a Non-Aqueous Phase.—J. B. O'Sullivan: The Application of the Quinhydrone Electrode to the Measurement of P_H Values in Solutions containing Copper Ions and other Divalent Ions.—J. A. V. Butler: Co-ordination and Valency.—E. D. Campbell: A Chemical Theory of Remanent Magnetism.

ARISTOTELIAN SOCIETY (at University of London Club, Gower Street), at 8.—Miss L. S. Stebbing: Logical Categories.

MEDICO-PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at Birmingham University).

TUESDAY, JULY 7.

MEDICO-PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at Birmingham University).—Sir Frederick Mott: Presidential Address.

INSTITUTION OF MECHANICAL ENGINEERS (Summer Meeting) (at Newcastle-upon-Tyne). (Continued on July 8, 9, 10.)

WEDNESDAY, JULY 8.

MEDICO-PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at Birmingham University).—Dr. G. A. Auden: Encephalitis Lethargica and its Psychological Implications.

THURSDAY, JULY 9.

DIESEL ENGINE USERS' ASSOCIATION (at Town Hall, Maidenhead), at 8.—C. O. Milton: The Working of the Ruston Mechanical Injection Engine.

TUBERCULOSIS SOCIETY OF SCOTLAND (at 6 Drumsheugh Gardens, Edinburgh), at 4.30.—Prof. H. Moellgaard and Prof. K. Faber: The Sanocrysin (gold) Treatment of Tuberculosis.

MEDICO-PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at Birmingham University).—Dr. Graves: Incidence of Chronic Sepsis in Mental Disease.—Dr. Pickworth: The Iodine Content of Thyroid Glands.

FRIDAY, JULY 10.

MEDICO-PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at Birmingham University).—Dr. A. M. McCutcheon: The Institutional Treatment of Mental Deficiency.—Dr. W. A. Potts: Delinquency.—Dr. H. Smith: The Psychopathic Personality.

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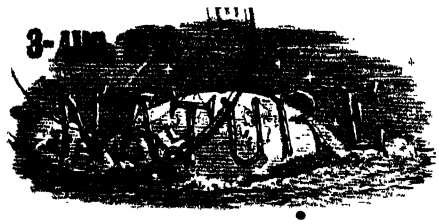

SATURDAY, JULY 11, 1925.

CONTENTS.

Science in Boys' Schools: The Administrative Aspect.[1]

THE issue by the Board of Education of the pamphlet before us is opportune, having regard to the development of secondary schools now being taken in hand. The report expresses the views of five of H.M. Inspectors and deals more particularly with observations in 39 boys' schools, mostly urban. As a rule, the schools contained more than 400 pupils and had Advanced Courses; high value is rightly attributed to the institution of these courses, which have brought about improvements in apparatus and equipment—including libraries—and, best of all, secured more highly qualified teachers. Throughout the report, references appear to the primary need for securing teachers of sufficiently wide knowledge, breadth of interest, and business capacity in management of the science side of a school in all its details, financial and technical as well as professional. The science master must be competent to design and revise syllabuses, to draft requisitions, to organise the economical use and repair of apparatus. It is suggested that university training departments should teach laboratory management, the need of which is even greater among science mistresses than with men.

The whole report is evidently the result of careful, fair-minded observation, and if the constructive suggestions are too restrained, there are fairly plain hints to any science master who looks for guidance. He is urged to aim at a really good standard of equipment, and school authorities are advised to provide for the gradual carrying out of well-planned schemes extending over a few years. There is no doubt that much can be done thus, particularly with subjects like electricity and optics where the apparatus is practically permanent.

The neglect of biological studies, and the narrowness of the syllabuses, are attributed to the over-specialisation which the universities require in candidates for degrees. At Cambridge and London, mathematics, physics and chemistry suffice for the preliminary years of the degree course. Boys who are not introduced to biology before leaving school seldom take up such study later—"in this matter we are in a vicious circle." It may be pointed out, however, that some alert headmasters of the larger Public Schools are developing biological classes, securing thereby an infusion of valuable thinking into the higher forms and an avenue to open scholarships which is not at all crowded at present. More than this is needed to cure the too urbanised outlook of our boys, but perhaps there is better hope for biology introduced from above to supply the sixth form "specialist" than from the

[1] Report of an Enquiry into the Conditions affecting the Teaching of Science in Secondary Schools for Boys in England. Pp. 28. (London: H.M. Stationery Office, 1925.) 3d. net.

nature study of the preparatory school. One wonders what would have happened if biology had changed places with engineering in the growth of Oundle School.

Another weakness in the present administration is the inadequacy of the provision of laboratory attendants. This is bad economy. An example is given of a very efficient school in which the laboratories are economically run, that is, with wise expenditure and without waste. The cost of apparatus and materials is 9*s*. per head and of wages 7*s*. 6*d*. per head, which is about one-third of the corresponding figures for the larger public schools. It would have been worth while to point out that to leave an unskilled youth to clean up is to expose a laboratory to risk of destruction by fire.

In view of the number of new schools now being planned, it is to be hoped that the Board of Education will issue some suggestions on the planning of general and advanced laboratories for boys and girls respectively. It is extremely difficult to alter a block of science buildings, and too many laboratories are built on a wrong assumption as to the number of pupils to be taught as a class. More and more pressure to reduce the staffing ratio will come, partly as the result of Burnham scales, and the Board of Education will be compelled to face the problem of the desirable size of classes in practical work.

In connexion with the Burnham Scales, it is unfortunate that the Board of Education refuses to recognise works experience as qualifying in any way for service increments. Two examples come to mind, both of university graduates, where recognition was granted by the local education authority and refused by the Board of Education. One of these had first-rate works experience and has designed and made, with the aid of his boys, most of the really good equipment for teaching mechanics and electricity in his school. The other had experience as assistant in the Cavendish Laboratory which has been of immense help to his teaching. Both men have now to accept lower salaries than if they had become teachers without such experience. Not all works experience is valuable, but it is sheer folly to put obstacles to teaching in secondary schools in the way of such men as those to whom we have referred. It is to be hoped that the new award will leave appointing authorities some discretionary power of recognition of such experience in instrument-making as calls for the study of scientific principles and the acquisition of manipulative skill.

In their concluding observations the inspectors return to the first essential—the quality of the teacher. Quite rightly, credit is given to the Science Masters' Association and the *School Science Review* for the useful work done in promoting discussion and interchange of opinion among teachers. A science teacher and inspector of long experience wrote recently to express his "deep indebtedness to NATURE for invaluable help during all my teaching career, especially during the years when I was almost cut off from science workers except for the holidays when the British Association brought the needed companionship of fellow-workers." Without insisting on any particular journal, it may be regarded as a bad sign if a science master is neglecting current scientific literature. The short courses arranged for vacations by the Board of Education are excellent, and they are widely appreciated. Why are half the applications refused? If the Board is unwilling to spend the money, this is another bad economy. But considering the pressure in the opposite direction, it is perhaps fairer to thank the Board for all it is doing, especially the successful attention by which the courses are made of such direct value in the school-teaching of science. We are grateful for this Report, which we hope will be studied in detail by headmasters as well as science masters, and also by the administrative side of the Board.

The Unity of Social Science.

The Earth before History: Man's Origin and the Origin of Life. By Edmond Perrier. Pp. xxiv+345. 15*s*. net.

Prehistoric Man: a General Outline of Prehistory. By Jacques de Morgan. Pp. xxiii+304. 12*s*. 6*d*. net.

Social Organisation. By Dr. W. H. R. Rivers. Edited by W. J. Perry. Pp. xi+226. 10*s*. 6*d*. net.

Language: a Linguistic Introduction to History. By Prof. J. Vendryes. Translated by Dr. Paul Radin. Pp. xxx+378. 16*s*. net.

History and Literature of Christianity from Tertullian to Boethius. By Prof. Pierre de Labriolle. Translated from the French by Herbert Wilson. Pp. xxiii+555. 25*s*. net.

The Threshold of the Pacific: an Account of the Social Organisation, Magic and Religion of the People of San Cristoval in the Solomon Islands. By Dr. C. E. Fox. Pp. xvi+379+14 plates. 18*s*. net.

The History of Civilisation Series. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, Inc., 1924–1925.)

SOCIAL and cultural scholarship, or as we call it in its beginnings, humanism, was, in the development of modern European thought, born before natural science. But it has been badly out-distanced by its younger sister, and only of late can it be seen emerging out of disorganisation and chaos. Nor is the road quite clear yet. Is there any unity in the vast medley of "histories" and "philosophies" whether of language or of literature, of art or of political institutions, of

economics or of morals, of law or of religion? In what relation do they stand to the old-fashioned history, pure and simple? Is *sociology* merely a new name for these studies taken in bulk, or does it stand for an attempt at unification in method, aim, and the adjustment of tasks?

To these questions, and to many other detailed ones, there is no answer yet on which all can be agreed, though philosophers and methodologists have been busy discussing them for some time, especially in France. There is, however, a marked tendency at present among the specialists as well as among those who survey matters from epistemological points of vantage to come into touch with each other, to recognise the unity of social science and to co-ordinate their work so as to avoid unnecessary duplication, to eliminate unhealthy specialism, and to foster the sole aim of humanism—the knowledge of man's nature, of his social organisation and of his culture.

The History of Civilisation Series, some volumes of which form the subject of this notice, promises to be perhaps the most important contribution so far undertaken towards the task of organisation and systematisation of the social studies. A glance at the prospectus makes us anticipate a library of masterpieces, for the best workers of France, Great Britain and some other countries are contributing from their own speciality and are attempting to bring it into line with the contributions from neighbouring fields and with the results of general sociology. Including all the volumes of the important French collection "L'Évolution de l'humanité," started a year or two ago and now in progress, the English Library, edited by Mr. C. K. Ogden, of Magdalene College, Cambridge, contains additions and improvements which will place it, no doubt, above its continental counterpart. The volumes already issued in English fully bear out our best hopes, and those additions which do not belong to the French series, the volumes by Dr. Rivers and Dr. Fox, establish its claim to superiority.

The whole plan of the English series is in itself a vindication of the unity of social science. Arranged so as to include all manifestations of human culture accessible to the eye of science, it follows roughly a combined historical and geographical plan. Starting from the most comprehensive picture, the empty earth in the midst of the empty universe awaiting the arrival of man, it passes then to the gradual development of organic life and the early history of mankind. These initial stages, described in the volumes of MM. Perrier and de Morgan, are accompanied by a series of introductory works which give a theoretical account of the various aspects of human culture: social organisation (by Dr. Rivers) and language (by Prof. Vendryes), the two tools of human action and of human thought; the geographical and the racial factors (in two volumes by MM. Febvre and Pittard); an epitome of man's political evolution (in the book of MM. Morel and Davy, "From Tribe to Empire"); a volume on man's primeval domesticity ("Woman's Place in Simple Societies," by Prof. J. L. Myres), and "Cycles in History" by the same writer.

The story then begins at the traditional cradle of culture, the ancient East, on the holy banks of the Nile, the Euphrates and Tigris, and on the shores of the Mediterranean, where the origins and history of the early Empires and their civilisations are described. Remaining within this geographical area, we follow the lead of time, and after having been shown the growth of the Ægean civilisation and the formation of the Greek people, we study the history of Greece in all its wonderful cultural achievements; next, in obedience to historical destinies, hegemony has to be surrendered to Rome, with the laws, politics and economic organisation of which we are then concerned, from the humble republican beginnings to the final expansion of the Empire. This brings us far beyond the geographical boundaries of the Mediterranean basin to the vast areas occupied by the Teutonic peoples to the north, the Persian, Indian and Chinese civilisation to the east, and the Mongol cultures of Central Asia. All these cultures will be studied in a series of monographs in a special section which closes the big division devoted to pre-history and antiquity. The second division will contain volumes on Christian religion, on the break-up of the Roman Empire, on the religious imperialisms of Christianity and Islam, on the political, social, economic and intellectual evolution in the Middle Ages and modern times. The English library contains besides all this several special sections, one on the histories of various subjects, such as medicine, money, costume, witchcraft and what-not; a section on Oriental culture, on historical ethnology, and a few more special sections not yet exhaustively announced, dealing with modern history.

The field of social science is thus fully and comprehensively covered in the English library. But this summary following merely geographical and chronological lines does not do full justice to the merits of the plan and of the achievements of the series, so far as they have been laid before us. It is the nature of the subjects treated in each group which constitutes its importance and makes it absolutely unique, as the first fully scientific history of civilisation in the English language. For there is no doubt that a deep modification in our conception of history has taken place during the last generation or so.

Take, for example, the history of Greece or Rome.

For most of us it has been, and still remains, the kernel of historical reality and the standard of our cultural values. Ancient Greece especially embodies for us the retrospective ideal of heroism, beauty and wisdom shining in the glory of a unique setting, of a chosen people and of an irrevocable past. We have our Golden Age in this myth of Greek culture, of Roman statesmanship, and this myth has been one of the main civilising forces from the Renaissance up to the present day. However science might deal with this mythology, scholars, dreamers and metaphysicians will still read into certain epochs of history an inspiring epic, a thrilling drama, a revelation of purpose and wisdom in destiny, a moral inspiration which allows man to bear the gloom and oppression of his own time. The reality of Homeric fights, of the Biblical stories and the myth of classical antiquity, will remain untouched for ever by the most destructive of "higher criticisms."

This is well, for we want our myth to remain intact, while at the same time the spirit of science forces history into accomplishing a different task from that of glorifying and idealising the past or of making it into a dramatic play of national destinies. The new history cannot carry out its work without the help of social science, psychology and a comparative study of culture. Scientific history, after it has thrown overboard drama, sentiment and myth, after it has introduced the most rigorous methods of scrutinising and reconstructing sources, still stands helpless before its main task: and that is to build up the process of human development in terms of personality and character as they work upon masses of people and as they solve questions of organisation and politics, of taxation and other economic arrangements, of warfare and education, of domestic, moral and religious institutions. For the knowledge of personality and character the historian might repair to the psychologist; in the study of organisation and politics the sociologist might help him; the scrutiny of values, whether material or moral, has to be carried on in collaboration with economics, the science of material culture, ethics and other normative disciplines.

Yet in all this the historian will find that he has quite as much to give as to take, for each of his auxiliary sciences has suffered by conducting its work single-handed and upon a somewhat artificially specialised material. The student of psychology has worked on an isolated, individual mind, suspended *in vacuo*, and he has wasted much of his time therefore in studying an unreal figment. Endless "sociologies" have been written upon a subject constructed *ad hoc*, whether it be the "group mind" or the "consciousness of kind," "imitation" or "race war" conceived as unique sociological principles, the "purely formal" in human organisation or the "exclusively organic." Economists have created another figment for science in the mathematically economic man who follows the purely economic motive. The moralist made his "absolute good," his "categorical imperative" or his "moral sense," and proceeded forthwith to study and to worship the idol fashioned by his own hands. Each specialist foredoomed his results by working on a figment. For human nature cannot be cut up into bits, nor man's mental endowment separated from his social habits or his material culture, or his moral and economic values. The human mind, with its plastic instincts shaped into cultural habits, its reason bound up with language and its emotional life determined by social bonds, values and ideals, is an integral subject of study. Specialisation there must be, and it probably will have to run on the traditional lines of psychology, sociology, economics, ethics and so on. But this specialisation must be the result of a central theory of human culture, this term of course embracing the human mind, the factors of organisation and material civilisation.

In this the historian, coming with his concrete, full-blooded reality of an individual civilisation at a definite epoch evolved by a definite race, forces the specialists to face the real problem. For in the concrete reality of life, regarded comprehensively and examined scientifically, we see how all the aspects intermingle and influence one another, each sufficiently independent to require a specialised study, each at the same time so deeply influenced by the others that it must be studied against the background of the whole culture.

We can see this method well exemplified in the scheme of the Greek section in this library. The ethnographic foundation of Greek culture is given in the first volume on the formation of the Greek people. Economics, religion, art, science, politics are then studied in separate contributions, each written in a sociological spirit, each giving an analysis of one aspect of Greek culture, yet all connected into one comprehensive picture. The analysis of any other part of the scheme shows the same plan, and the names of the writers vouch for the fact that every contribution will be written in the modern scientific, that is, sociological spirit.

It is in this that the English series shows its superiority over the French library. In glancing over the prospectus of this latter, one or two capital omissions at once strike us forcibly. A series conceived in the sociological spirit should place perhaps two subjects in the forefront of its attention: economics and the study of domestic life. The importance of the former has been underestimated for ages by the historian, though it has certainly been over-emphasised in the modern theories of historical materialism. Nevertheless, childish as it is to regard wealth as the unique *vera causa* of all cultural process, its study cannot be omitted from any

scientific account of any type of civilisation. Even modern anthropology has begun to discover in theory and in field-work that the production and acquisition of material goods play a far greater part in primitive life than was ever suspected by the earlier authorities. In historical times, economics play an important part in the shaping of political history, of social organisation and of the other cultural pursuits, but certainly not as a unique and sufficient cause of everything, but as an individual with which man cannot dispense, and which in different [illegible] fluence the student must not ignore.

[illegible] other factor, domesticity and family life, is, so to speak, the crucial test of really scientific anthropology [illegible] history. The most ubiquitous elements in man's [illegible]—the school of his infancy, the background of his youth and the aim of his age—the family and the household, are certainly the cell of human society, and their constitution influences deeply the other forms of social grouping in any culture. Modern psychology teaches us also that the early influences of the family leave a deep impression on the individual's mind and in consequence upon the whole cultural activity of a community. There is no doubt, however, that the scientific treatment of domesticity in its influence upon culture is extremely difficult. Just because it is so deep and powerful an influence, it is to some extent intangible and invisible; so that the modern historian finds in his sources only scanty and indirect information about the domestic life of the average individual, although archæology, folk-lore and even comparative anthropology can assist him in this to a great extent.

It is therefore a remarkable omission that in the French series the two subjects of economics and domestic life should have been almost completely neglected. This gap will be filled by Mr. Ogden in the English library, and he has summoned to this task the help of competent writers. The volume by Prof. J. L. Myres on "Woman's Place in Simple Societies," which is announced; the works on "Life and Labour in Greece and Rome," by M. Glotz and M. Paul Louis; the contribution on the regime of the castes in Ancient India, by Mr. G. S. Ghurye; the book on popular life in the last Roman Empire by Prof. N. Baynes; the volumes on "Life and Labour in the Middle Ages and in Modern Europe," by M. Boissonade and Prof. Renard, and on "Women in Medieval Times," by Dr. Eileen Power; the "Philosophy of Capitalism" and the "History of Money," both by Dr. T. E. Gregory—all these, confined to the English series—promise by their subjects to be among the most interesting volumes, and by their authors, among those of the greatest value in the library.

The comparison between the French and English series and the advantage derived from the combination of the best forces in two countries suggest the one serious criticism that could be made with regard to the present enterprise—the almost complete lack of German and American contributions. German scholarship in works referring to classical antiquity, in comparative linguistics, in many domains of psychology, in historical economics, jurisprudence and in the theory of the state is unrivalled. No one will suspect Mr. Ogden, the War-time editor of the *Cambridge Magazine*, of narrow-minded chauvinism or of any of the futile though unfortunately widespread prejudice against the science of a great nation. It is therefore to be hoped that in the pending additions to the series announced in the prospectus there will be included the works of some of the leading humanists of Germany.

It is also to be hoped that some of the best works of the United States to be published within the next few years will find their way into this series and make it even more representative and international. For in this big collective work on civilisation the unity of human culture and of human science should be manifested by the co-operation of different nations as well as in the intrinsic unity of the subject with which the authors are dealing.

B. MALINOWSKI.

Real Builders of America.

A Popular History of American Invention. Edited by Waldemar Kaempffert. Vol. 1: Transportation, Communication, and Power. Pp. xvi + 577. Vol. 2: Material Resources and Labor-Saving Machines. Pp. xiv + 457. (New York and London: Charles Scribner's Sons, 1924.) 63*s.* net.

TO the extraordinary development of the United States during the last century, history presents no parallel. From a position of comparative insignificance she has risen to be the greatest manufacturing nation the world has ever seen. The growth of her industries has indeed been remarkable, and the real builders of her fortunes have not been her statesmen and soldiers, but her mechanics and inventors. While, however, the story of her national progress is fairly familiar, a knowledge of her pioneers and their work is not general, and it was therefore a happy thought to bring together this series of essays giving a review of the great things achieved.

It was to an American audience that Lord Playfair once remarked, "Science has no country though its investigators have birthplaces." In some degree the same may be said of invention, and frequently the plan of writing the history of either science or invention from the national point of view is unsatisfactory. Still, there are advantages if the work is done impartially, and fortunately the editor and writers of this popular

history of American invention have not been too eager to emphasise the work of their countrymen at the expense of others, and the sketches, though by many writers, are throughout eminently readable, entertaining, and informing. The work is well balanced; good accounts are given of scientific discoveries and mechanical inventions made in Europe before being taken up in the United States, and a large proportion of the illustrations are from the Science Museum, South Kensington, the Deutsches Museum of Munich, and other institutions. We thus read the old stories of Watt and Stephenson, Volta and Faraday, Gutenburg, and Daguerre and Daimler, in a new setting.

There are in all 27 chapters by 18 different writers, and the work is divided into five main parts devoted to transportation, communication, power, material resources, and labour-saving machines. The opening chapter deals with railways, and in the year which is seeing the celebration of the centenary of the Stockton and Darlington Railway this is of especial interest. American locomotives have long ago surpassed European engines in size and power, though not in speed and efficiency, and we are told that the largest goods engine, the Virginian, weighs 450 tons, and has no less than 10,725 square feet of heating surface in her boiler. The *Rocket* had 137 square feet. Several of the chapters give striking statistics; and in the first chapter it is stated that the United States now has 69,000 locomotives, 57,000 passenger cars, and 2,500,000 freight cars. The railways employ about 2,000,000 men.

After the story of the railways come those of the steam-boat, electric traction, motor cars and aeroplanes. The next group of chapters is devoted to printing, typewriting—in 1919 the world produced 875,000 typewriters, of which 775,000 were American—telegraphs, telephones, wireless, photography, "Pictures that Live and Move," and phonographs. Though the moving picture business owes its main development to American enterprise, a fair account is given of the work of Faraday, Plateau, Horner, Marey, and others, but the birthplace of the "movies" was Philadelphia, where at the Academy of Music in February 1870 Henry Heyl threw on the screen a series of pictures showing the movements of a couple waltzing. The reader is taken behind the scenes of a studio, and it will perhaps come as news to many to read that some of the accidents seen on the films are real ones, and that Hubert Kittles, a well-known motorist, "was in bed for weeks with broken bones after a realistic motor cycle race, in which the story called for a real tumble."

The second volume of the history treats of the great metallurgical, oil, timber, machine tool, and textile industries. We see how the inventions of Bessemer and Siemens led to the rise of Pittsburg, how petroleum wells are sunk, how giant forest trees are felled and transported, how the agriculture tractor came into being, and how boots are made by machinery, enabling the States to turn out 300,000,000 pairs of shoes a year. Machine tools had their birth in the shops of Wilkinson, Bramah, and Maudslay, but to-day they are designed by the staffs of professional inventors maintained by the great companies. They are characteristically American in the sense that they have been brought into being to solve the problem of producing vast quantities of all articles cheaply in the face of high labour costs.

In the space of 1000 pages it was, of course, impossible for the writers to deal with all the pioneers. We thus miss any mention of James Rumsey and his steamboat, of Ericsson and his gun turret, of the work of the great iron master John Fritz, and of Robert M'Alpine, the father of the wood pulp industry. In the chapter on the incandescent lamp, Swan should certainly have been referred to. But apart from these and other minor criticisms, it must be conceded that this popular history is one of the best books of its kind which have yet appeared.

Bird Life on the Norfolk Broads.

Broadland Birds. By E. L. Turner. Pp. xvi + 172 + 51 plates. (London: *Country Life*, Ltd., 1924.) 15*s.* net.

THAT skilful watcher and photographer of birds, Miss E. L. Turner, has published what she describes as "just a record of my own personal observations of the birds I have lived with for twenty years." She has had opportunities which many will envy, and has used them in a way which all must admire. She has spent the whole of many seasons in a house-boat on Hickling Broad, devoting herself entirely to the observation of bird-life in that interesting locality. By dint of much patient watching, she has acquired a great knowledge of the intimate lives of some of the most interesting and least accessible species. What she has learnt she faithfully records as a plain narrative, avoiding anthropomorphic interpretation on one hand and not attempting theoretical deduction on the other. The result will give much pleasure to lovers of birds, and at the same time is of considerable scientific interest.

Several noteworthy ornithological events are recorded in these pages, such as the first nesting of the bittern, in 1911, after it had been for long regarded as extinct as a British breeding bird, and the nesting of the ruff in 1907 after an interval of many years. The bittern; happily, is now re-established, but so far the ruff has not been found to nest regularly. Miss Turner also describes the first nesting of the cormorant in

East Anglia for a century—on a high tree, as is commonly the case inland in Ireland and on the Continent.

Other chapters in the book deal with birds which range from comparatively uncommon species, such as the stone-curlew and the bearded tit, to familiar birds which may be found in marshlands throughout the country. About all of them we are told something of interest, but we are at the same time warned against hasty generalisation from the behaviour of a few individuals, because close observation reveals great differences in behaviour between one and another of the same species.

The writer has not always restricted her stay in Norfolk to the nesting season, but has also spent the autumn and winter in her house-boat. In late summer she has seen migrating swifts arriving from the north-east, appearing first at dawn as a faint cloud in the zenith which rapidly drops earthwards and resolves itself into a great host of birds. In autumn she has seen the vast concourse of millions of starlings which roost in the reed-beds and perform aerial evolutions on such a scale that the line may "stretch from Potter Heigham Church on the south to Hickling Hill on the north-west, a distance of five miles." In mid-winter, with the broads nearly ice-bound, she has seen such things as fifty-four swans, in strict chevron formation, passing across the face of the moon.

Miss Turner apparently began as a bird photographer, but she has become much more than that. Her book would indeed have been well worth reading, as a record of observations, even without the excellent photographs with which it is illustrated, although naturally they add much to its charm. Many of them are of value in depicting action instead of being portraits only.

Our Bookshelf.

La Géochimie. Par Prof. W. Vernadsky. (Nouvelle Collection scientifique.) Pp. vi + 404. (Paris: Félix Alcan, 1924.) 12 francs.

THIS book of four chapters is a reprint, with some amplification, of lectures given by Prof. Vernadsky at the Sorbonne during 1922–23. The first chapter, which opens with the questionable statement that geochemistry is a science new to the twentieth century, is devoted to general considerations, including the subdivision of the earth's outer layers or envelopes according to their physical, chemical and biological characteristics. Apart from the atmospheric layers, Vernadsky's various groupings of these envelopes may be indicated roughly as follows:

Superficial	Water and superficial crust	Biosphere.
Metamorphic	Sedimentary and granitic	Lithosphere.
Magmatic	Basaltic	Magmosphere.

Minerals stable in the superficial envelope are termed *vadose*, those in the metamorphic envelope *phreatic*, and those in the magmatic envelope *juvenile*. Cycles of change in the chemical composition of minerals are distinguished as *primary cycles* if their completion is effected in two or more envelopes, and *secondary cycles* if they are completed within the limits of a single envelope. The application of these notions is illustrated by a detailed account of the geochemical history of manganese, which furnishes an example of a primary cycle involving juvenile, phreatic and vadose changes. Chap. ii. deals with silica and the silicates, Chap. iii. with carbon and living matter, and Chap. iv. with the radioactive elements.

A notable feature of the book is the large place allotted by the author to biochemical agencies in mineral transformations. His account of the dynamic equilibrium between carbon dioxide and living matter, or what he calls the *vital cycle*, is of special interest from this point of view. His discussion of biochemical evidence, however, shows that he is an enthusiastic supporter rather than a critical examiner of the claims made for biochemical factors in geochemical changes. An example of this is provided by his reference to the process of laterisation, and his easy conviction that the process is clearly a biochemical one.

In a general way, Prof. Vernadsky's views are less likely to be challenged by chemists and physicists than by geologists; but it will be admitted by all that his book is full of interest on account of its largeness of outlook and its ample recognition of the many-sided character of geochemical problems. T. C.

Physics in Industry: Lectures delivered before the Institute of Physics. Vol. 2. By Dr. J. W. Mellor, Dr. A. E. Oxley, Prof. C. H. Desch. Pp. 48 + 6 plates. (London: Oxford University Press, 1924.) 3s. net.

THE appearance of a second volume of these valuable lectures on physics in industry evokes the thought—and the fear—that before long we may have a special society and a special journal devoted to this subject. But for the fact that engineering has hitherto been regarded as the one and only field of applied physics that matters, these would probably have seen the light many years ago. Industrial chemistry has long been in the public eye: industrial physics, apart from engineering, has yet to come into its own.

In his absorbing lecture on the applications of physics to the ceramic industries, Dr. Mellor was compelled by the tyranny of time to confine his remarks to applications that are not common to other industries, such as the drying of clay and clay wares, thermal and contraction strains in ceramic goods, and the electrical and thermal expansion of glazes. He deals lucidly and suggestively with these topics, and his general remarks on applied physics and physicists, if not entirely novel, are very sound. Dr. Oxley, as physicist to the British Cotton Research Association, has found, contrary to expectation, a vast field for research in the textile industries, and particularly in bringing scientific method into the testing-room. He points out that the distinguishing feature of physical research in this field is that, owing to great variability in the raw materials, series of observations sometimes involving many

thousands of readings have to be made, and conclusions drawn from them by statistical methods. As examples of the work to be done he discusses the testing of rigidity, elasticity under strains, effects of variable stresses, fatigue, regularity of the spun thread, and the appearance of the finished fabric. He concludes with the recommendation that abstracts on the progress of textile research should be given their place in the chief scientific journals. The third lecture, on the physicist in metallurgy, shows the enormous importance of physics in later-day metallurgical research and practice. The most numerous and varied applications of physics, states Prof. Desch, are connected with the heating, forging, hardening, and alloying of metals. Magnetism, he tells us, is becoming of increasing importance, and atomic structure, properties of crystals and X-ray analysis, are all of actual and potential value in metallurgical research. The lectures reach a high standard, and the introductory remarks by the Hon. Sir Charles Parsons concerning the rôle of higher mathematics in applied physical research should not be overlooked.

Arabische Alchemisten. Von Julius Ruska. 2: Ga'far al-Ṣādiq, der sechste Imām. Mit einer Nachbildung der Handschrift Gotha A. 1292 (Haleb 338) in Manuldruck. (Heidelberger akten der Von-Portheim-Stiftung, Heft 10.) Pp. 128+62. (Heidelberg: Carl Winter's Universitätsbuchhandlung, 1924.) 7·20 gold marks.

PROF. RUSKA'S erudition is equalled only by his energy. He has now followed up his monograph on Chālid ibn Jazīd (see NATURE, September 20, 1924, p. 427) with an interesting and important memoir on Ja'far al-Ṣādiq, the sixth Imām. Included in the memoir are the text and a translation (with full notes) of an alchemical treatise falsely attributed to Ja'far, the "Book of the Letter of Ja'far al-Ṣādiq on the Knowledge of the Art and of the Noble Stone." The text is a facsimile of MS. *A.* 1292 at Gotha, and is supplemented by additions and variations from a manuscript in the Library at Rampur.

The memoir is divided into six sections: (i.) Ja'far al-Ṣādiq in history and legend; (ii.) the writings attributed to Ja'far; (iii.) Ja'far as the teacher of Jābir ibn Ḥayyān; (iv.) Ja'far as the author of chemical works; (v. and vi.) translation and text of the alchemical treatise mentioned above. Prof. Ruska's main conclusions are that Ja'far had nothing whatever to do with alchemy, that all the alchemical works attributed to him are spurious, and that he could not have been the master of the great Jābir. He says that it is quite unthinkable (*völlig undenkbar*) that Ja'far al-Ṣādiq could, at Medina, have come into any contact with either practical or theoretical alchemy. If this conclusion is justified, it follows that Jābir could not have learnt alchemy from him, and Prof. Ruska is therefore forced to the extremely important conclusion that "all writings ascribed to Jābir, in which Ja'far al-Ṣādiq is represented as his master and teacher, are to be regarded as falsifications of a later date."

Prof. Ruska's conclusions are certain to have the happy result of provoking much further research, but we feel that it is as yet too early to give unqualified assent to his criterion for judging the authenticity of works ascribed to Jābir. His memoir is undoubtedly the most important contribution to our knowledge of early Islamic chemistry which has been made in the present century. E. J. H.

Statics: including Hydrostatics and the Elements of the Theory of Elasticity. By Dr. Horace Lamb. Second edition. Pp. xii+357. (Cambridge: At the University Press, 1924.) 12*s.* 6*d.* net.

PROF. LAMB'S books on the various branches of mechanics require no introduction to the modern teacher and student of applied mathematics. By their fluency of diction, their easy mathematical style and their lucid presentation of the subject, they have displaced most of the old-established works. The interest in the announcement of a new edition lies consequently rather in what modifications the author could possibly make to improve an already excellent work.

This second edition of "Statics" differs from the earlier edition merely in the portion dealing with elastic problems. There has been made, to the chapter on the extension of bars, a valuable addition on the treatment of redundancies. Castigliano's theorem of least energy is developed, with Southwell's simple and elegant proof. The chapter on the flexure and torsion of bars now covers the case of curved bars and the collapse of a ring under pressure, while the final chapter on stresses in cylindrical and spherical shells now includes the case of rotating cylindrical shafts.

These additions are consistent with the general tendency of all the author's work, to combine with clear and lucid mathematics a close association with the realities of the subject. This new edition merely emphasises the debt which all teachers owe to Prof. Lamb's inspiration.

Valenzkräfte und Röntgenspektren: zwei Aufsatze über das Elektronengebäude des Atoms. Von Prof. Dr. W. Kossel. Zweite, vermehrte Auflage. Pp. iv+89. (Berlin: Julius Springer, 1924.) 3·60 gold marks.

VALENCY and X-ray spectra may appear to have little in common, but valency is essentially connected with the number and distribution of the outer electrons of the atom, while X-ray spectra provide the most powerful weapon for the investigation of those which are more tightly bound; together, therefore, these two essays involve the whole question of electron distribution. The first section contains an interesting account of the various theories of valency, and considerable space is devoted to the bearing of the crystal lattice on the problem. This new edition has been slightly enlarged, notably by the inclusion of a brief account of the Lewis-Langmuir theory. Bohr's work on the periodic table is not discussed here, since the author has decided, rightly perhaps, that it could be treated more adequately in the second essay. Here Dr. Kossel has succeeded in giving, in small compass, an admirable account of X-ray spectra and their bearing on atomic structure. He emphasises the fact that an investigation of the energy levels indicated by these spectra leads to conclusions similar to those deduced from valency considerations. The first edition was deservedly popular, and no doubt this second edition will meet with equal success, giving, as it does, a clear yet concise account of these phenomena.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

X-ray Crystal Analysis as an Auxiliary in Organic Chemical Research.

AT the suggestion of Prof. W. L. Bragg, I recently sent to Dr. G. Shearer, of the Davy Faraday Research Laboratory, a series of four keto-acids which had been synthesised by my wife. Dr. Shearer was not aware of the identity of the substances, which were, however, stated to belong to the series

$$CH_3(CH_2)_m . CO . (CH_2)_n . CO_2H.$$

Actually (A) was $CH_3(CH_2)_{11}CO(CH_2)_8 . CO_2H$,
(B) was $CH_3(CH_2)_{11}CO(CH_2)_4 . CO_2H$,
(C) was $CH_3(CH_2)_7 . CO(CH_2)_6 . CO_2H$,
and (D) was $CH_3(CH_2)_8CO(CH_2)_8 . CO_2H$.

No case so complex had been tried in the aliphatic series previously, and yet, from the X-ray examination of a minute amount of these compounds, Dr. Shearer was able to deduce that (A), (B), (C), and (D) have chains containing 22, 18, 16, and 19 carbon atoms respectively. Furthermore, it was possible to assign positions to the carbonyl groups in (A), (B), (C), and (D) from a consideration of the distribution of intensity among the various orders of reflection from the principal planes, and it was found that the carbonyl group is 0·52, 0·67, 0·55, and 0·50 respectively, of the whole length of the molecule from the end terminating in a methyl group. The corresponding theoretical values are 0·54, 0·65, 0·50, and 0·48, which means a maximum error of one carbon atom in placing the oxygen.

The outcome, considering the difficulties, is remarkable, and this is surely the most noteworthy invasion which the physicist has yet made of the domain of the purely structural organic chemist. The specimen (B), for example, is identical with an acid found by Bougault and Charaux (1911) in various species of Lactarius, and therefore called lactarinic acid. Its relation to stearic acid was quickly realised, but a determination of the situation of the carbonyl group involved a longer investigation. Should such a case arise again, we can replace the analytical research by an X-ray examination and confirm the conclusions by direct synthesis.

In view of the importance of the normal-chain unsaturated acids in biochemistry and their ready conversion into crystalline oxygenated derivatives, there can be little doubt that Dr. Shearer's work will find many applications even in this restricted field. On a broad view the possibilities are limitless, and gradually more and more groups of carbon compounds will become amenable to this kind of direct examination. Our more difficult problems, such as that presented by the determination of the molecular structure of strychnine, cannot be completely solved by X-ray analysis at the present time, yet, even here, Sir William Bragg has recently made a suggestion in regard to a possible utilisation of the method. It is to *stain* the molecule with heavy halogen atoms and locate these, at least in the crystal.

A different kind of use for the X-ray spectrograph in organic chemistry is illustrated by a further incident. Mrs. Robinson has synthesised the two keto-stearic acids, $CH_3(CH_2)_7 . CO(CH_2)_8 . CO_2H$ and $CH_3(CH_2)_8 . CO . (CH_2)_7 . CO_2H$, which are the possible products of hydration of stearolic acid, $CH_3(CH_2)_7 . C \equiv C . (CH_2)_7 . CO_2H$. It is stated in the literature that the addition of the elements of water to stearolic acid gives only the first-mentioned keto-stearic acid, but both synthetical acids melt at a higher temperature than does the substance derived from stearolic acid. Possibly the latter is a mixture of the two, and in order to confirm this view we had recourse to Dr. Shearer. He found that the principal spacings in the three specimens were identical, but that the intensity distributions among the different orders of reflection from the principal planes showed marked differences in the case of the two homogeneous acids, whilst the intensity distributions were intermediate in the case of the acid derived from stearolic acid. It is almost certain, therefore, that the acetylenic linkage of stearolic acid is hydrated in each of the theoretically possible directions when the substance is treated successively with sulphuric acid and water.

R. ROBINSON.

The University, Manchester.

The Structure of Stearic and Stearolic Acid.

CRYSTALS of fatty acids and similar long chain compounds are difficult to obtain in sizes large enough to give good "single crystal" X-ray photographs. Mr. W. B. Saville has succeeded in growing fairly large and thick crystals of stearic acid. They were obtained from a saturated solution of stearic acid in carbon bisulphide.

X-ray analysis shows that stearic acid crystals obtained under these conditions are monoclinic. The size of the unit cell is found to be: a 5·60, b 7·38, c 50·0 A.U., and β 59·7°. The choice of the unit cell is to a certain extent arbitrary, these data give the lowest indices to the strongest reflecting planes. The density is slightly more than 1·05; this gives four molecules to the unit cell. Previous work on series of similar compounds led to the conclusion that the carbon atoms are arranged in long and uniform chains. The c axis in the present case has been put in a plane of highest density. The chain which coincides nearest with the c axis is found to be of the tetrahedral type if the diameter of the carbon atom is taken over from the diamond structure.

A single crystal of stearolic acid investigated by means of X-rays gave different photograms from those obtained from stearic acid. The symmetry is lower, and all the data seem to indicate that these crystals are triclinic. Stearolic acid has the same number of carbon atoms as stearic acid (18), but it has a triple bond in the middle of the chain.

ALEX. MULLER.

Davy Faraday Laboratory,
Royal Institution,
July 1.

Solar Activity and Atmospheric Electricity.

IN view of the footnote to Dr. Chree's article in NATURE of June 27, and an explanatory note received from him recently that his article was in type before he saw my article in the March issue of the journal *Terrestrial Magnetism*, it would scarcely be fair to him to make any comments. However, I shall be glad to send a reprint of my article to any one interested in becoming acquainted with all the points involved. Furthermore, since my March article, we have found Dr. Chree's recommendation made at the Madrid meeting of the Geophysical Union impracticable. Meteorologists have likewise not adopted his recommendation for their purposes.

We are investigating other interesting questions in atmospheric electricity, but are obliged first to recompute the early Kew observations, because Dr. Chree did not utilise concomitant observations at Greenwich. In the hope that British investigators will assist in securing the desired world-wide distribution of electric observatories during the present solar cycle, permit me to direct attention to the fact that the two observatories in Great Britain are unfavourably located, and that the only atmospheric electric observations in British oversea countries are being made in Australia and Samoa at the expense of the Carnegie Institution of Washington. Other countries are co operating. Also, no earth current observations to our knowledge are being made under British auspices.

LOUIS A. BAUER.

Washington, D.C., June 24.

THE article by me in NATURE to which Dr. Bauer refers included a discussion of Potsdam data. These data had also been treated by Dr. Bauer in the March number of *Terrestrial Magnetism*. Dr. Bauer having sent me a copy of his article, I informed him when acknowledging it that I had also discussed the Potsdam data in an article which was already in type. I wished to make it clear—to prevent misunderstanding—that my article, the conclusions in which differed from Dr. Bauer's, was written quite independently. Beyond informing Dr. Bauer that our conclusions differed, and continue to differ, I did not tell him the substance of my article but only that of the footnote.

In the absence of information, he would seem to have supposed that the article referred to a suggestion, originally made in a presidential address to the Royal Meteorological Society (Quarterly Journal Roy. Met. Soc., vol. 50, p. 96), that a comparison should be made between the meteorological and electrical conditions on the international magnetic quiet and disturbed days. The British meteorological delegates to the meeting of the International Union of Geodesy and Geophysics, held last year at Madrid, put forward an analogous proposition, but another proposition originating from Denmark received a greater number of votes. As to the practicability of the proposition, I am naturally disposed to prefer the opinion of the meteorologists on the British National Committee of Geodesy and Geophysics to Dr. Bauer's.

In his references to the unfavourable situation, for observations on atmospheric electricity, of existing British observatories, I think Dr. Bauer must have forgotten Eskdalemuir, which unlike Kew and Greenwich is remote from any large town. He is also presumably unaware that some provision has been made for electrical observations at the new observatory at Lerwick.

We are all, I hope, aware of the energy and enterprise of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. Our only regret is that Mr. Carnegie, or some other millionaire, has not similarly endowed a geophysical institution for the British Empire.

CHARLES CHREE.

June 25.

The Sun-Clock.

I AM the fortunate custodian of a model—the only one in Great Britain—of a new kind of sun-dial, the invention of Prof. W. E. Cooke, the Government Astronomer of Sydney, N.S.W.

It is much more than a sun-dial. It is provided with a movable pointer geared to the hands of an ordinary clock-face, and by virtue of this it is aptly called the sun-clock.

At any time when the sun is shining, it is turned as directed in one simple motion, and immediately G.M.T. is read on an ordinary clock dial to within half a minute, the seasonal variations of solar time and the difference due to the longitude of the place in which it is set up being compensated for in the design of the instrument.

Reading the time on an ordinary sun-dial involves first the observation of the precise position of the edge of the shadow, which, owing to lack of definition, may be very difficult to read to an accuracy of one minute. Reference must then be made to an equation table, and whatever number of minutes are appropriate to the date must be added or subtracted in order to arrive at mean solar time. Then, to ascertain Greenwich Mean Time, a further correction is required for the longitude of the position of the sun-dial, east or west of Greenwich.

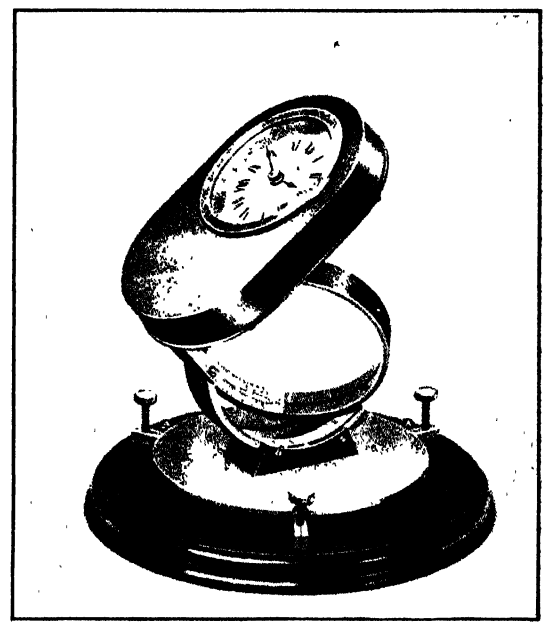

FIG. 1. The sun-clock.

In the sun-clock no such mental gymnastics are required. It will be seen from the illustration (Fig. 1) that instead of a gnomon, there is a pivoted brass ring the axis of which is in exactly the same plane as the gnomon would be if there was one; that is to say, its pivots lie along a line which points true north, and the angle of its tilt is equal to the latitude of the place at which it is fixed. There is a small hole on one side of the ring, well countersunk on the outside. On the inner surface of the ring, diametrically opposite to this little aperture, is engraved an analemma or graph in the form of a figure 8 to show the equation of time, or the difference between apparent and mean time, for every day in the year.

When it is desired to know the time, the ring is turned until the spot of sunlight is on the analemma. The ring is geared to the hands of a clock, and in the act of turning it they are set to G.M.T. It is not necessary to look at the date, but, incidentally, the date is there, to the very day, indicated by the spot of light, and had Robinson Crusoe been the happy possessor of a sun-clock it would have served him as

a perpetual calendar, and he need not have notched his tree.

It is said that there is nothing new under the sun, but this appears to me to be an original invention and a brilliant one.

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The Amani Research Institute.

MAY I be allowed to add to the timely and sympathetic article on the Amani Research Institute in NATURE of June 20, p. 933, some notes on a point not emphasised by you, namely, the possibilities of Cinchona cultivation at Amani?

From the outbreak of war in 1914 Amani was used as a refuge camp for women and children, and, until its occupation by the British in 1916, its resources, thanks to the abilities of the German scientific staff, were ruthlessly exploited for the benefit of the German armies in the field. Thus, of the "economic products," catalogued under 67 heads, manufactured at the Institute, may be mentioned 830 kgm. of "plant butter" from the seeds of *Allanblackia Stuhlmannii*, 15,000 bottles of "Amani whisky" (a fearsome liquor) and medicinal alcohol, and about 400 bottles of castor oil. But most important of all were 136 kgm. of quinine sulphate, extracted at Amani, and 4000 kgm. of Cinchona bark sent to be worked up at the veterinary station at Mpapua. Prof. A. Zimmermann, the German Director of Amani, came to East Africa from Java, and brought with him both seeds of Cinchona and a knowledge of its cultivation: and the quinine plantations in the event proved one of the best investments the German Government ever made. They certainly helped materially to keep the German troops in the field. Of the three varieties of Cinchona grown in the Institute grounds—*C. Ledgeriana*, *C. succirubra*, and a hybrid (Java seed) between these two—the last assayed so well and earned so remarkable a report from the Imperial Institute that it is deserving of a wide publicity. Full details can be found in the Bulletin of the Imperial Institute, vol. 16, No. 3: I need only extract the analysis of the bark:

No. 4. *C. Ledgeriana* × *C. succirubra*.

	Per cent.
Moisture	7·50
Total alkaloid	11·30
Quinine	8·41
Cinchonidine	nil
Yield of crystallised quinine sulphate	11·21

and the manufacturer's opinion:

"The manufacturers stated that sample No. 4, the hybrid from *C. Ledgeriana* × *C. succirubra*, is one of the highest quinine-yielding barks they have examined, being fully equal to the finest Ledger bark from Java."

So far as experience has gone, Cinchona flourishes in East Africa only in the East Usambara Mountains, where the atmosphere is moist and the temperature remarkably low for the elevation (under 4000 ft.). Certainly I have not heard of its doing really well elsewhere in Tanganyika Territory, or in Kenya Colony. But in the neighbourhood of Amani there are thousands of acres of virgin forest land which appear to be suitable for Cinchona. My instructions, in view of the report on the hybrid, were to devote special attention to quinine cultivation, and when I left Amani at the end of 1923 we had some promising plantations of Ledgeriana and the hybrid (Amani seed) coming on, and, thanks to Prof. Greenish and the Director of the Wellcome Bureau of Scientific Research, some assays of the bark of known, mature hybrid trees, which confirmed the original analysis and promised to open up a tempting field of research. It had always been my hope that eventually Amani would do for the East African Colonies what Sir David Prain had done for India, and supply most of the quinine needed locally, particularly for native consumption.

ALLEYNE LEECHMAN.
(Lately Director, Amani Research Institute.)
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Harpur Street, Bedford.

Spectroscopic Evidence of *J*-Transformation of X-rays.

IN our letter to NATURE of April 25 on spectroscopic evidence of *J*-transformation of X-rays, we pointed out that there are alternative conclusions regarding the experimental results which were taken from the Table V. given by Prof. Siegbahn in "Über die Röntgenspektren der chemischen Elemente," Jahrbuch der Radioaktivität, 1916. These conclusions are: *either* the wave-length determinations quoted are inaccurate to the extent of more than 1 per cent., *or* the discontinuities which occur in Ka_1, Ka_2, $K\beta$ are real and are due to *J*-transformation of X-rays. Prof. Siegbahn gives as his judgment that the irregularities are due to experimental error: we accept this.

The values given in the Jahrbuch are evidently those of Malmer according to Prof. Siegbahn "not very concordant measurements" (NATURE, July 4, p. 11). At the same time Prof. Siegbahn states that Malmer's "measurements give no evidence of such a sudden change in the slope of the curve as shown in the letter of Messrs. Khastgir and Watson." We should like to point out, however, that the irregularities referred to by us have been noticed independently by J. M. Cork (*Phys. Rev.*, Feb. 1925, p. 197). Further, Günther, so late as 1924, has quoted these same values in a booklet of X-ray spectroscopic measurements, and we employed them because they constituted at that time the only available complete set of wave-lengths throughout the region where the *J*-phenomenon appears.

Mr. Nipper (NATURE, July 4, p. 12) is evidently not acquainted with the facts concerning the *J*-phenomenon (see *Phil. Mag.*, May 1925), otherwise he would not have advanced as evidence against our main contention the fact that Siegbahn's later—or for that matter, any other spectroscopist's—values do not show a discontinuity (increase in λ as Z is increased from 51 to 52). It was explicitly stated in our letter, and it has been emphasised by Barkla on many occasions, that wave-length is not the only factor which determines whether or not *J*-transformation of X-rays takes place in transmission through matter. Certain critical conditions are necessary: the character of the whole of the radiation transmitted appears to exercise a very important controlling influence (see NATURE, June 20, 1925, p. 942). The *J*-transformation evidently did not occur in the case of Siegbahn's recent determinations of wave-length, and we therefore obtain from them no evidence of the *J*-phenomenon.

S. R. KHASTGIR.
W. H. WATSON.
Physical Laboratory,
University of Edinburgh,
June 19.

The Cresswell Engravings.

MR. J. WILFRID JACKSON, in his letter to NATURE of June 6, p. 874, refers to the occasion when he first saw these engravings and says, "I also told him it was a mistake to outline the figures in chinese white." I am quite sure Mr. Jackson did not intend it to be so, but, none the less, this is a misleading statement and open to a wrong interpretation. The engravings were not outlined in white, and only one specimen, the reindeer piece, has ever been so outlined. This example is executed in very fine, thin, lines upon bone afterwards scorched black by fire, hence the drawing is not readily seen unless the bone is held at the correct angle. For photographic purposes chinese white was *rubbed* into the lines, as a satisfactory picture could not be obtained otherwise.

Sir William Boyd Dawkins asked me to send the engravings to him for inspection, and photographs were sent with them. As an act of courtesy, the reindeer piece was forwarded in the condition in which photographed, and my covering letter expressly pointed out that it was sent thus outlined to assist him in his examination and that the outlining could be removed immediately by the application of a sponge or damp handkerchief. As neither he nor Mr. Jackson took the trouble to do this, they are scarcely in a position to express a trustworthy opinion upon the character of the lines composing the figure. Had they done so, they would have seen at once that the lines are clean, sharp, continuous cuts, and bear no resemblance whatever to the half-tunnels formed by roots. Mr. Jackson's interpretation of certain selected markings upon an ancient skull are interesting, but no one familiar with the technique of Palæolithic art could mistake these broken lines upon the portion he illustrates for the handiwork of man.

The authenticity of the engravings from Mother Grundy's Parlour, Cresswell, is testified by the authorities at the British Museum, by Mr. Miles C. Burkitt of Cambridge, the foremost British authority on Palæolithic art, Prof. Sollas, and others. The considered opinion (with full knowledge of Mr. Jackson's objection) of M. L'Abbé Breuil relative to the specimens was reported in NATURE of May 2, p. 658.

A. LESLIE ARMSTRONG.

14 Swaledale Rd.,
Sheffield, June 25.

Ancient Science.

PERMIT me to supplement two passages in NATURE of June 20.

P. 963, *Accuracy of Weighing in the Eighth Century*.—In 1885 I found a hoard of fifty-eight Athenian tetradrachms of uniform type and unworn condition. I reduced the chloride on each by means of zinc, and so obtained the original weights. The average was 264·2 grains, with a mean variation of 0·6 grain. Thus 4/5 of the coinage of Athens would have passed the remedy of the Mint in modern England. This must evidently have been the result of careful weighing and adjustment. In a group of small Gaulish silver coins, from Chalons-sur-Saône, which I bought in Paris, the average is 29·85 grains and the mean variation 0·33 grain, so it is evident the balance was used in Gaul. Weights are found in prehistoric Egypt so far back as 8000 B.C.

P. 937, *Egyptian Mathematics*.—The most frequent kind of problem in the Egyptian mathematical papyrus, that of dividing a stock of food, seems to be the origin of their fractional system. If 2 loaves have to be divided among 7 people, the obvious way is to divide the stock into 8 parts, distribute 7, and divide the remaining quarter of a loaf into 7 parts. Thus 2/7 naturally becomes 1/4 + 1/28. The same system was used in dividing the profits of Scotch fishing-boats. The master served out a pound to himself, a pound to each of his crew, and a pound for the boat. When there were not enough pounds to go round, the remainder was changed into half-sovereigns, the next remainder into half-crowns, then shillings, then pence, and finally sweeties. The system seems obvious in all cases where written accounts were not prepared.

FLINDERS PETRIE.

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On the Daily Use of an Immersion Condenser.

IN daily observations on the structure of chromosomes fixed and stained in iron-acetocarmine (see *American Naturalist*, 1921, pp. 573-574), where the limit of resolution in the microscope must be maintained, it has been determined that water is, on the whole, to be preferred to cedar oil as an immersion fluid for the condenser. The corrections necessary are readily made. (1) By centring a large enough meniscus lens from a photographic camera below the condenser (Hartridge); and varying the distance of the light source, and the thickness of the object slide, until the best image of a grating close to the light source is obtained. (2) By unscrewing sufficiently the top lens or lenses of the condenser. Slides can easily be selected of approximately the required thickness. The test for aplanatism is, of course, to diaphragm the source of light until its image is equal to or smaller than the field of view, and then observe the light circle at the back of the objective.

Cells in iron-acetocarmine become plastic after a certain time, and can be squeezed flat by slight pressure. When the chromosomes are thus spread out in contact with the cover-glass there is a good opportunity to seek for possible visibility of the chains of genes, either with the Watson dark field condenser of 1·3-1·4 aperture, or with the arc and two tourmalines, as mentioned by Beck in his lately published manual.

JOHN BELLING.

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New York.

The Faraday Benzene Centenary and Kekulé.

IN connexion with the benzene centenary, it may perhaps be pointed out that the name Kekulé is not French. August Kekulé, born in Darmstadt (1829; he died in Bonn, 1896), was a descendant of Wilhelm Dionysius Kekule (or Keckhule) von Stradonitz, who came from Bohemia in the seventeenth century. The é was probably adopted to guard against the suppression of the final e; that has been done in other cases. August Kekulé himself spelt his name with é, even in his earliest papers, before he went to Ghent and Bonn, and still in 1890, when his researches on the construction of aromatic compounds and the twenty-fifth anniversary of his benzene-hexagon (Bonn, 1865) were commemorated by an international Kekulé celebration at Berlin. But he had by that time (1890) resumed the full name A. K. von Stradonitz. The present members of the family spell their name without the accent.

H. BORNS.

Chiswick, June 30.

Ether-Drift Experiments at Mount Wilson.

By Prof. DAYTON C. MILLER, Case School of Applied Science, Cleveland, Ohio.

THE Michelson-Morley experiment for determining the relative motion of the earth and the luminiferous ether, the "ether-drift experiment," was first performed in Cleveland in the year 1887, by Prof. Albert A. Michelson and the late Prof. Edward W. Morley. The theory of the experiment and a description of the apparatus was published in the *Philosophical Magazine* for 1887, and has been repeated in many text-books since that time. They announced their conclusions as follows: "Considering the motion of the earth in its orbit only . . . the observations show that the relative motion of the earth and the ether is probably less than one-sixth the earth's orbital velocity and certainly less than one-fourth." (That is, it is less than 7·5 kilometres per second.) This result was considered by many as a null result, often called a negative result, and by some was thought to throw grave doubts upon the validity of the hypothesis of the luminiferous ether.

At the International Congress of Physics, held in Paris in 1900, Lord Kelvin expressed the conviction that the experiment should be repeated with a more sensitive apparatus. The present writer, in collaboration with Prof. Morley, constructed an interferometer about four times as sensitive as that used in the first experiments, having a light path of 224 feet, equal to about 150,000,000 wave-lengths. In this instrument a relative velocity of the earth and ether equal to the earth's orbital velocity would be indicated by a displacement of the interference fringes equal to 1·5 fringes. This apparatus was used in the basement of the Physical Laboratory of Case School of Applied Science in Cleveland, observations being made in 1904 and 1905. The result of these observations was published in the *Philosophical Magazine* for May 1905, as follows: "We may, therefore, declare that the experiment shows that if the ether near the apparatus did not move with it, the difference in velocity was less than 3·5 kilometres per second unless the effect on the materials annulled the effect sought. Some have thought that this experiment only proves that the ether in a certain basement-room is carried along with it. We desire, therefore, to place the apparatus on a hill to see if an effect can be there detected."

In the autumn of 1905 Morley and Miller removed this interferometer from the college laboratory to a site on Euclid Heights, Cleveland, at an altitude of 300 feet above Lake Erie and free from obstruction of buildings. Five preliminary observations were made which gave indication of a positive effect as of an ether-drift of about one-tenth of the then expected drift. We were compelled to discontinue these experiments by circumstances beyond our control, before any definite results could be obtained.

The indication of a small positive effect made it seem necessary to continue the experiments, but it was thought desirable that further observations should be carried out at a much higher altitude. Prof. Morley retired from active work in 1906 and the continuance of the observations was long delayed. The suitable opportunity for continuing the experiments came in 1921, and upon the invitation of Prof. George E. Hale, Director of the Mount Wilson Observatory in California, the interferometer which had been used in 1905 was remounted at the Mount Wilson Observatory. Four distinct groups of observations have now been made in this location: in March and April 1921, in November and December 1921, in August and September 1924, and in March and April 1925. The first observations at this Observatory gave a definite, positive result considerably larger than that previously obtained in Cleveland, being equal to about one-third of the earth's orbital velocity.

On the simple theory of the ether-drift experiment, it is presumed that the system of interference fringes which is observed will suffer a periodic displacement as the interferometer is rotated in the horizontal plane, this displacement being proportional to the relative motion of the earth and the ether. The rotation of the earth on its axis causes the plane of the interferometer to move as though it were on the surface of a cone the axis of which coincides with that of the earth, and thus to take many different space orientations. It is only that component of the actual drift which lies in the horizontal plane of the interferometer at the moment of observation which can be observed. Therefore, the *apparent* azimuth and magnitude of the drift should change with the time of observation. A drift perpendicular to the plane of the interferometer will produce no effect whatever; it is quite possible that this condition may occur at certain times of the year.

It was suggested that the small observed effect might be due to magnetism acting on the steel frame of the interferometer, or that it might be due to radiant heat or other instrumental disturbances. The trying out of the various suggestions has involved continuous experimentation during the last four years, in which time every suspected cause of disturbance has been investigated, and it has been shown that none of these causes is responsible for the observed displacement.

In the summer of 1921 the steel frame of the interferometer was dismounted and a base of one piece of concrete reinforced with brass was cast in place on the mercury float. All the metal parts were made of aluminium or brass; thus the entire apparatus was free from magnetic effects and the possible effects due to heat were much reduced. In December 1921, 42 sets of observations consisting of 900 single measures of the drift were made with the non-magnetic interferometer. These show a positive effect as of an ether-drift which is entirely consistent with the observations of April 1921. Many variations of incidental conditions were tried at this epoch. Observations were made with rotations of the interferometer clockwise and counter-clockwise, with a rapid rotation and a very slow rotation, with the interferometer extremely out of level, due to the loading of the float on one side. Many variations of procedure in observing and recording were tried. The results of the observations were not affected by any of these changes.

The entire apparatus was returned to the laboratory

in Cleveland. During the years 1922 and 1923, many trials were made under various conditions which could be controlled and with many modifications of the arrangements of parts of the apparatus. An arrangement of prisms and mirrors was made so that the source of light could be placed outside the observing room, and a further complication of mirrors was tried for observing the fringes from a stationary telescope. Methods of photographic registration by means of a motion-picture camera were tried. Various sources of light were employed, including sunlight and the electric arc. Finally, an arrangement was perfected for making observations with an astronomical telescope having an objective of five inches aperture and a magnification of fifty diameters. The source of light adopted was a large acetylene lamp of the kind commonly used for automobile headlights. An extended series of experiments was made to determine the influence of inequality of temperature and of radiant heat, and various insulating covers were provided for the base of the interferometer and for the light path. These experiments proved that under the conditions of actual observation, the periodic displacement could not possibly be produced by temperature effects. An extended investigation in the laboratory demonstrated that the full-period effect mentioned in the preliminary report on the Mount Wilson observations is a necessary geometrical result of the adjustment of mirrors when fringes of finite width are used, and that the effect vanishes only for fringes of infinite width, as is presumed in the simple theory of the experiment.

In July 1924 the interferometer was taken again to Mount Wilson and mounted on a new site where the temperature conditions were more favourable than those of 1921. The interferometer house was also mounted with a different orientation. Again the observations showed a definite positive effect corresponding to the observations previously made at Mount Wilson. The observations on Mount Wilson were resumed in March 1925, and continued until about the middle of April, during which time 1600 measures of the drift were made. Again many variations in detail of arrangement of parts and in methods of observing were made without in any way altering the result. Throughout the latter epoch of observations the conditions were exceptionally good. The observations of April 1925 give results almost identical with those of April 1921, notwithstanding that the interferometer had been rebuilt and that a different system of illumination and different methods of observation were employed, and that it was mounted on a new site in a house differently oriented.

The interferometer readings being plotted, give directly by harmonic analysis the azimuth and magnitude of the ether-drift. There are no corrections of any kind to be applied to the observed values. In the work so far, every reading of the drift made at Mount Wilson has been included at its full value; no observation has been omitted because it seemed to be poor, and no "weights" have been applied to reduce the influence on the result, since no assumption has been made as to the expected result. It may be added that while the readings are being made, neither the observer nor the recorder can form the slightest idea as to whether any periodicity is present, much less as to the direction or amount of such periodicity.

The ether-drift experiments at Mount Wilson during the last four years, 1921 to 1925, consisting of about 5000 single measures of the drift, lead to the conclusion that there is a positive displacement of the interference fringes, such as would be produced by a relative motion of the earth and the ether at this Observatory, of approximately ten kilometres per second, being about one-third of the orbital velocity of the earth. By comparison with the earlier Cleveland observations, this suggests a partial drag of the ether by the earth, which decreases with altitude. A more extended account of these observations is given in the Proceedings of the National Academy of Sciences for June 1925.

Dr. Ludwik Silberstein, in his letter to NATURE of May 23, has pointed out that these results, indicating a partial drag of the ether by the earth, "are easily explicable by means of the Stokes' ether concept, as modified by Planck and Lorentz," as discussed in a paper by Silberstein in the *Philosophical Magazine* for February 1920.

The final test of these observations is whether they lead to a rational and wholly consistent indication of a constant motion of the solar system in space, combined with the orbital motion of the earth and the daily rotation on its axis. There is a specific relation for a given latitude between the observed azimuth of drift and the sidereal time of observation. Observations at different sidereal times should show different azimuths, and all observations at the same sidereal time should show the same azimuth for a given epoch. It is believed that a reconsideration of the Cleveland observations, from this point of view, will show that they are in accordance with this presumption, and will lead to the conclusion that the Michelson-Morley experiment does not and probably never has given a true zero result. A complete calculation of the observations, now in progress, together with further experiments to be made in the immediate future, should give definite indications regarding the absolute motion of the solar system in space.

The Science Exhibition at Wembley.

THE Science Exhibition arranged by a Committee of the Royal Society in the Government Pavilion at Wembley represents a great advance on the similar exhibition held last year, particularly as regards the section devoted to physics. The space available has been considerably extended and the equipment of the demonstration benches is much more adequate. Perhaps the most striking advance, however, is the admirably systematic manner in which it is now possible to present the exhibits, for these have been arranged on an underlying plan which gives unity to the whole and converts a collection of miscellaneous experiments into an orderly sequence of demonstrations, which are not only striking in themselves but also calculated to give visitors a very fair impression of the nature of modern physics and the scope of the problems to which it addresses itself. The key to this part of the exhibition is to be found in an enormous chart, some 24 ft. long,

showing the wave-lengths of electromagnetic radiation as a continuous series according to a logarithmic scale, the general nature of the radiation and the methods by which it is detected and generated being shown against each range of wave-lengths. This chart itself, which covers 60 octaves, is of considerable interest, particularly as regards the regions of overlap. For example, it has in recent years become possible to generate and detect radiation the wave-length of which is a few tenths of a millimetre both by thermal and by electromagnetic methods. It is a remarkable fact that it is now possible to use a scale of wave-lengths as a guide to a very representative series of physical experiments: it emphasises the change which has taken place in the orientation of scientific thought since the days when matter was everything and energy had not been defined, for now energy is paramount and matter is mentioned as an afterthought.

Bearing in mind the general scheme indicated by the chart, the visitor is conducted along a series of excellently appointed benches designed to illustrate the properties of the various types of radiation, beginning with the shortest. He is first introduced to the atom, as the source of gamma radiation, and this is represented by some new models in addition to apparatus which will be familiar to physicists. On the ceiling the relative distances of the electrons and nucleus in a neon atom are shown by means of coloured lamps, and further models, for which Prof. W. L. Bragg and Mr. D. R. Hartree are to be responsible, are awaited with interest. Another striking exhibit connected with atomic structure is an apparatus from the Clarendon Laboratory in which a single particle at a time, emitted by polonium, is made to break down the resistance of a small spark gap, the resulting current being made audible by means of amplifiers and a loud speaker. The properties of gamma rays are illustrated by a projection electroscope contributed by Dr. E. A. Owen, the rate of discharge being varied by placing various screens in the path of gamma rays emitted by radium.

Amongst the experiments connected with X-ray apparatus may be noted a very fine demonstration due to Mr. F. D. Edwards of the electric discharge through air at gradually decreasing pressure in a tube 4 ft. 6 in. long. The large scale of the apparatus makes these always beautiful effects very striking, and the rise in resistance of the tube at the highest and lowest pressures is indicated by sparks across a 10-inch alternative gap. A less familiar demonstration is afforded by de la Rive's apparatus, in which a luminous arc passes from an electrode at the top of a discharge tube to a ring electrode at the bottom, the core of an electromagnet being located in the axis of the ring. The arc is seen to rotate in one direction or the other according to the polarity imparted to the electromagnet. Dr. G. W. C. Kaye contributes a soft X-ray apparatus with which visitors can study the transparency of various substances by the aid of a fluorescent screen, and there are exhibits illustrating the application of X-rays to crystal structure. Bridging the gap between X-rays and ordinary ultra-violet light we have the Schumann X-rays, produced by the impact of electrons the velocity of which is measured by some hundred volts, and detected by their photo-electric effect on the insulated electrode of an electrometer. It was in this region that the "death-ray" was alleged to lie.

The ultra-violet range is illustrated by several demonstrations of which the most intriguing is perhaps one due to Sir Herbert Jackson, in which mixed visible and ultra-violet rays from a condensed aluminium spark are focussed by a quartz lens on a screen which fluoresces to ultra-violet rays of wave-length 1850 or 1860 A.U. The visible rays are found to be focussed at about 2 ft. from the lens and the ultra-violet of the above wave-lengths at about 8 inches, so that by moving the screen it is possible to find two differently coloured focal regions. Mr. Guild contributes a visible spectrum projected by means of a calcite prism. The existence of radiation beyond the visible spectrum is shown by means of a thermopile at one end and a zinc sulphide screen at the other, and the effect of interposing various colour filters is shown by a comparison of the filtered spectrum with a patch of otherwise white light which has passed through the filter. Dr. Curtis shows that on increasing an electric discharge through nitrogen by shunting the break of the induction coil with a condenser, the disruption of the nitrogen molecules changes a band spectrum into a line spectrum, and a similar contrast is obtained by Prof. Fowler by means of a flame arc containing calcium fluoride, the band spectrum due to the fluoride being accompanied by a line spectrum due to the dissociated elements. Prof. Horton and Dr. Ann Davies illustrate the nature of light emission with an apparatus for showing excitation potentials, and there are photoelectric cells in action contributed by the Clarendon Laboratory and Mr. T. H. Harrison. Interference phenomena in the visible range are represented by a Michelson interferometer (Mr. Twyman), Lippmann colour photographs (Mr. Gamble), diffraction gratings from the National Physical Laboratory (Mr. J. S. Clark), and a demonstration due to Prof. Rankine of the projection of an image of a luminous object by means of a spherical bicycle ball in place of a lens. Each point in the object throws a circular shadow of the ball having a white spot at its centre, and the aggregate of white spots forms the required image. Photographs can be reproduced by this method. Polarisation apparatus is shown by Prof. Cheshire.

For the infra-red region Mr. Twyman has a spectrometer with a rock-salt prism which can be turned by a micrometer screw so as to traverse the spectrum across a thermopile. The spectrum from 5,000 to 100,000 Å.U. can be explored in this way, and a Bunsen burner is shown to emit strongly in the neighbourhood of 44,000 Å.U. A caesium photo-electric cell, which is sensitive to infra-red rays, is contributed by the Clarendon Laboratory, an ebonite screen serving to filter out the visible light. The transition to wireless wave-lengths is afforded by Mr. F. E. Smith's demonstration of the production and heating effects of very short Hertzian waves, and by Sir William Bragg's example of Lindman's apparatus for rotating the plane of polarisation of such waves by means of an arrangement of metal spirals, the action being similar to that of quartz and other crystals which are optically active in the visible region.

The interest of the non-scientific visitor, for whose benefit the Exhibition is primarily intended, will no doubt be specially caught by the display of wireless

apparatus, of which a few examples only can be mentioned. The Lecher wires (Prof. Whiddington) will illuminate the conception of wave-length, and apparatus by Dr. Smith-Rose demonstrates the rectifying property on which crystal detectors depend. The determination of absolute frequency by Mr. D. W. Dye's recently perfected oscillograph system is also a feature in this section of the Exhibition. The cathode-ray oscillograph is caused to give a circular trace by means of crossed fields controlled through a valve by a standard tuning-fork, the ray completing the trace once per vibration of the fork. By the superimposition of a supplementary pair of crossed fields at high frequency the circular trace is transformed into a closed series of loops when the frequency is a harmonic of the fork frequency, and can be calculated from that and the number of loops. In this way standardised high frequencies can be obtained. The same apparatus is used to give wave form by transforming the circle into a long ellipse, and adding to the deflecting field which gives the minor diameters a further deflecting field proportional to the high frequency voltage. If the eccentricity of the ellipse be sufficient, the time base is substantially rectilinear and uniform. Direction finding is demonstrated by Dr. Smith-Rose, the currents produced in a rotatable coil by a neighbouring oscillator being read off from a galvanometer. Possibly if a pointer were fixed to the coil with its tip moving over a set of equidistant straight lines forming a scale, the galvanometer reading could be adjusted to give directly the sine of the inclination of the coil to the wave front, as indicated by the tip of the pointer. The General Electric Company illustrates in a striking way the problem of uneven filament-heating. In a diode valve the filament heating current is an A.C. from the source that supplies the anode volts, but the phase of the filament current can be varied. The brightest point on the filament is seen to move along the latter as the phase alters. The longest electromagnetic wave-lengths are represented by some experiments on audio-frequency currents.

Amongst the geophysical apparatus must be mentioned a working installation of the new Milne-Shaw seismograph, which employs an optical lever and Foucault-current damping. This instrument is exceedingly sensitive, giving a magnification of 500, and can even indicate the tilt of a coast due to tidal load. Records of the Japanese earthquake of September 1923 are exhibited.

The biological exhibits include all those which proved most attractive last year together with some additions, amongst which may be mentioned Prof. Groom's cultures of various species of fungus causing dry-rot in timber. Prof. Harris shows an apparatus for measuring the oxygen pressure of fresh blood, the blood and a comparison solution being contained in two quartz bottles which can be exposed to light containing ultra-violet radiation. It is shown that exposure to light promotes the absorption of oxygen and so alters the equilibrium point between the oxygen in the blood sample and that in the air above it. Dr. E. H. J. Schuster shows a respiration pump by means of which a detached organ or a headless trunk can be kept alive for some hours. In connexion with physiological demonstrations it is perhaps well to remind the public that with a few rare exceptions British biologists have been humane men who have recognised the imperative duty of using anaesthetics in experiments on living animals. In the physiological section is also classified an apparatus for measuring the compressional elasticity of films of fatty substances on water. The water surface is swept clean and the film is compressed by means of a measured force applied to a floating strip. The films are found to be monomolecular. The method has been used for estimating very small amounts of fat.

An attractive innovation is a miniature kinematographic projector by Kodak for which a number of scientific films have been obtained, including some high-speed films taken with the Heape and Grylls machine.

The Exhibition as a whole is an admirably conceived attempt to instruct the public as to the methods and aims of science, and is entitled to the support of all who have the interests of scientific prestige at heart. In conducting their unscientific friends through the series of demonstrations provided they will themselves derive no small profit and enjoyment. C. W. H.

Problems of the Rhone Delta.[1]

By R. D. OLDHAM, F.R.S.

III.

THE eastern branch of the Rhone has undergone changes, as extensive and remarkable as those of the western, though differing in character. In the early centuries of our era the mouth of the river is put, in the maritime itinerary of the Antonines, at 16 Roman miles from the port of Fossæ Marianæ, and from thence it was 30 miles by river to Arles. These distances fix the mouth of the river close by the present termination of the Vieux Rhône, or main channel during the seventeenth century, and this identification is borne out by the finding, in 1883, of an old boundary pillar with a Latin inscription, regarded as fifth or sixth century, which appears to show that it was set up near to the mouth of the Rhone. The place where it was found lies 3 km. west of the old river channel and 2 km. inland from the sea-face of the delta, and, whatever may be the exact age of this inscription, it must date from before the subsidence in the Dark Ages.

This subsidence brought about great changes; a large part of the seaward portion of the delta was submerged, leaving numerous islands of various sizes, the memory of which is partially preserved in local place names, and the mouth of the river proper receded to near, but not up to, the town of Arles.

When light again begins to dawn on the history of this region we find, in the description, by Roger de Hoveden, of the voyage of an English fleet along the coast in 1190, a statement that they passed an island called Odur, at the mouth of the Rhone, going up which river brings one to the fine city of Arles le Blanc. The identification of this Odur is certain; it is known at the present day as the Roque de Dour, or more simply La

[1] Continued from p. 19.

Roque, a low hill of about 25 feet high, rising from the alluvium of the delta, just west of the entrance to the Étang de Galéjon. In the form of Odor or Dor it appears on all the portolan maps, being given equal prominence with other more conspicuous towns, ports or landmarks, and evidently owed this prominence to its importance as marking the entry to the main channel leading to Arles. On a flat, low-lying coast, often indistinguishable in hazy weather, even so small a hill would form an important landmark.

The course of this channel can still be traced; it was up the Étang de Galéjon, and then westwards along the general course of an old river channel, known as the Bras Mort, to the neighbourhood of the village of Passon, on the banks of the Rhone. Along this line there is a strip of low-lying modern alluvium, bordered on both sides by higher ground, part of the old land surface of the Roman period. The Bras Mort was practicable for small boats, at any rate during part of the year, until it was artificially closed in 1642, but long before that it had ceased to be navigable by ships. The channel was, however, still in use at the beginning of the fifteenth century, and is described in a portolan, or book of sailing directions, printed at Venice in 1490, evidently from old manuscripts works of similar character, dating from the early part of the century.

The advance of the mouth of the river and successive closing of alternative channels of access to the town and port of Arles can be traced in the records of that city. From the commencement of the Middle Ages it claimed, and exercised, a control over the navigation of the Rhone, and, for the purpose of this control, maintained an armed and fortified post for the double purpose of levying tolls on the shipping and excluding undesirable, or piratical, intruders. The latter purpose made it desirable that the post should be as distant as possible from Arles itself; the former compelled it to be situated so near that the traffic had to pass it, that is to say, above the highest point where there was an alternative channel to the open sea. The earliest of these fortified posts or towers of which there is record was the Tour de Malusclat; the exact position of this has not been identified, but the name remains as that of a village, and it must have been on the western bank of the river a couple of miles or so above Passon, the place where the old channel from the Galéjon joined what is now the main stream of the Rhone. The date of construction of this tower is not known, but, about the middle of the fifteenth century, the advance of the mouth of the river having reached the neighbourhood of Passon, the channel leading to the Étang de Galéjon, and the Roque de Dour, became blocked by the alluvial deposits of the river, thereby closing what had been the principal channel of access. This made the situation of Tour de Malusclat no longer suitable, and, in 1469, the Council of Arles decided that it should be demolished and a new tower built farther down the channel.

The site of this new tower, afterwards known as the Tour de Belvar or Bolovard, has been identified, in the lands of the Grand Peloux, close to the left bank of the present channel, and nearly opposite where the Bras de Fer channel takes off from the river. It was not, as has been stated in some modern works, built on the actual sea-face of the delta, for maps of the seventeenth century, and records of law suits and grants of land in the thirteenth, show that there was land to the southwards, but the site was chosen because it lay at the junction of two alternative channels of access, and was the site, farthest from the city of Arles, at which the whole traffic of the river could be controlled by a single post. It remained in function for more than a century, during which the principal channel led southwards,

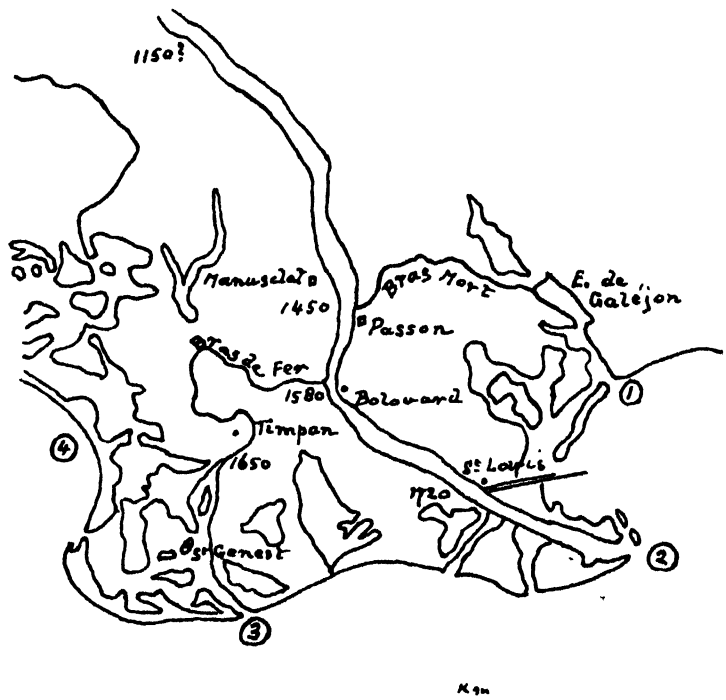

FIG. 4.—Lower course and mouth of the Rhone, showing position of the successive towers, approximate position of the mouth of the river at the dates indicated, and main channels of navigation. (1) Up to about 1450. (2) Until 1585 and again from 1720 to the present day. (3) From about 1585 to 1720. (4) Alternative channel, finally blocked about 1650.

much along the general course of the existing river channel. By 1587 the mouth of the river proper had advanced to this place, and the river, instead of continuing along the direct channel, broke away to the westwards, to follow the general course of the Bras de Fer.

The Tour de Bolovard was thus left stranded and, after a while, sold and demolished, all but the foundations, which still remain. Meanwhile, a new tower had been built, in 1607, known as the Tour de Tampan, on the banks of the Vieux Rhône, and about 8 km. inland from the present coast-line. Here, again, the tower was not built on the sea-face, for old maps show that a group of islands, separated by channels, extended out to very near the existing sea-face of the delta; the site was evidently selected because, in addition to the channel afterwards followed by the river, there was another navigable channel, called the Rajeirol, which led, from a little below the tower, into the Golfe de Beauduc.

In course of time the river mouth passed this channel and blocked it up, so the Tour de Tampan was abandoned and a new one, the Tour de St. Genest, was built, in 1656, on what was evidently an island of the old land surface of Roman times, and not far from the spot where the boundary stone with Latin inscription was discovered in 1883.

This tower, at last, lay close to the sea-face of the delta; the most advanced outpost of the old land was not much more than a mile to the southwards, and, when the river extended past this point, it no longer ended in a sheltered inlet, but in the open sea. The formation of an extension of the delta, by the silt brought down the river, began, and a difficult and dangerous bar developed, the hindrance to navigation becoming more acute as the river mouth was pushed farther out into the open sea. Many schemes and proposals for remedying this were considered, during the latter half of the seventeenth century, but none had been initiated when, in 1711, the river broke away along the line of the old navigable channel, past the site of the Tour de Bolovard, to enter the sea close by the place where, in 1737, the Tour St. Louis was built, close to the sea-face of the land, as it then stood. Since then there has been no further change in the channels farther upstream, and the whole river is so firmly controlled by protective embankments that none is likely to occur.

From this brief history it appears that the mouth of the Rhone, which was near Passon about the middle of the fifteenth century, had advanced to the present coast-line at the Vieux Rhône by the middle of the seventeenth, and early in the following century was at the coast-line of that time near the modern town of St. Louis. This advance of the mouth of the river does not, however, mean a growth of the delta by a depth of ten kilometres along a breadth of about twenty; this would mean an increase of nearly a square kilometre a year, fully five times the rate of growth of the delta during the last two centuries. It was, however, not from the open sea that the land was reclaimed, but from a number of shallow channels separating islands of old alluvium, thus reducing largely both the area and depth of the new deposits, and in this way the changes, which are known to have taken place, are not merely to be explained by subsidence of the land during the Dark Ages, but in themselves become evidence of the reality of the change of level, independently deduced from evidence of a wholly different character.

(*To be continued.*)

Two New Elements of the Manganese Group.

THE recent discovery of the two missing elements of the manganese group by Dr. Noddack and Fräulein Tacke of Berlin is of interest not only as an important step towards the completion of the periodic table but also on account of the methods used in the research. In these days no one branch of science can afford to stand aloof from the others, and perhaps it would be difficult to find a happier example of the way in which the various sciences can combine towards a successful result than this discovery of the eka-manganeses. Chemistry, physics and mineralogy have all played their parts, and the result is that the number of gaps between hydrogen and uranium in the periodic table has been reduced from five to three.

In the preliminary account of their work which has been published in *Die Naturwissenschaften* for June 26, p. 567, the authors give, in addition to the results of their investigations, the arguments on which their line of attack was based. In the first place, it was necessary to find some material in which the new elements might reasonably be expected to occur. A study of the neighbouring elements suggested two possible sources; the first that of the platinum ores, the second a mineral such as columbite. The platinum ores contain the elements chromium to copper, ruthenium to silver, osmium to gold, or, expressed in atomic numbers, 24 to 29, 44 to 47, and 76 to 79. Columbite, on the other hand, contains, among many other elements, those of atomic number 39 to 42 and 71 to 74. Here, therefore, were two minerals in either of which the missing elements 43 and 75 might well be found.

In endeavouring to form an estimate of the amounts of the elements 43 and 75 which might be present in these minerals, the authors employed an ingenious argument. The constitution of the earth's crust is now fairly well known, and it is possible to assign to the various elements numbers indicating the frequency of their occurrence. A study of these figures indicates that elements of odd atomic number are less common than those of even atomic number; in fact, an odd element is ten or twenty times less abundant than the succeeding even element. As ruthenium (44) and osmium (76) constitute about 2×10^{-12} and 2×10^{-11} of the earth's crust, it was deduced that the elements 43 and 75 would form about 10^{-13} and 10^{-12} of the earth's outer layer. As the frequency of occurrence of platinum is 10^{-9}, the amount of the elements 43 and 75 in the platinum ores should be from 10^{-3} to 10^{-4}, and as niobium, one of the chief constituents of columbite, forms 10^{-7} of the earth's surface, columbite was estimated to contain from 10^{-5} to 10^{-6} of the missing elements. In this way Drs. Noddack and Tacke obtained some idea of the extent to which the chemical processes of extraction would have to be carried if measurable quantities of the new substances were to be obtained.

It was a fairly straightforward matter to predict some of the chemical properties of the new elements from a consideration of their neighbours in the periodic table. Thus it appeared probable that both would form oxides X_2O_7, and that these oxides would readily sublime on account of the small difference of temperature between their melting- and boiling-points. Again, for example, it was argued that the eka-manganeses would resemble chromium in so far as no sulphides would be formed from aqueous solutions. These and other chemical properties were used in the chemical treatment of the ores.

Attention was first directed to the platinum ores as offering the highest chance of success. After preliminary chemical treatment, the residue of 80 gm. of a Russian ore was strongly heated alternately in oxygen and hydrogen. Among the deposits on the walls of the vessel was found a very small quantity of white microscopic needle crystals. These needles became dark in

colour when treated with a stream of hydrogen sulphide, while a subsequent heating in oxygen resulted in the reappearance of the white sublimation product on the colder part of the vessel. An aqueous solution of these crystals gave no precipitate either with hydrogen sulphide or ammonium sulphide. As such behaviour was to be expected from the elements 43 and 75 and from none of the other known elements in the solution, it was presumed that this substance contained the missing elements. Further attempts at concentration resulted in a loss of the material.

Through lack of further supplies of the platinum ores, the authors turned their attention to columbite, resolving at the same time to carry out the final analysis by X-rays. From about 1 kgm. of the mineral the greater part of the iron, niobium and tantalum was removed by sodium hydroxide and sodium nitrate; the filtered solution was treated with hydrogen sulphide and concentrated to a volume of 50 c.c. By the use of mercurous nitrate, about one gram of precipitate was obtained from this solution. A repetition of the process gave about 50 mgm., estimated to contain about 5 per cent. of the elements 43 and 75. Heating in oxygen gave once more the white sublimate. The quantity available was too small for direct application to the anticathode of the X-ray tube. It was, therefore, mixed with niobic acid and examined spectroscopically in this form.

X-ray spectra probably provide the best method for the detection of a small quantity (say 0·1 per cent.) of an element in a mixture. These spectra are much simpler in nature than the optical spectra, and, unlike the latter, do not depend on the mode of excitation or on the state of chemical combination. The wave-lengths are determined by the atomic number alone. From Moseley's laws it is possible to predict the wave-lengths of the various lines with considerable accuracy. A further check is provided by an examination of the relative intensities of the lines. An X-ray investigation of the final products of the chemical processes was carried out by Drs. Berg and Tacke, and a search made for the K series of the element 43 and for the L series of 75. The result was entirely successful. Three lines appeared on the plates corresponding to wave-lengths 0·601, 0·672 and 0·675 Å.U., whereas the calculated values of the $K\beta_1$, $K\alpha_1$ and $K\alpha_2$ lines for an element 43 are 0·600, 0·673 and 0·678 Å.U. These are the three strong lines in the K series, and their relative intensities agreed with the well-known ratios. In the spectral region 1·20 to 1·43 Å.U. there occurred five lines which were identified as the $L\alpha_1$, $L\alpha_2$, $L\beta_1$, $L\beta_2$ and $L\beta_3$ lines of an element of atomic number 75. The numerical agreement was excellent; thus, the observed and calculated wave-lengths of the $L\alpha_1$ line were 1·4299 and 1·4306 Å.U. There is always a chance that the lines may be wrongly identified, but the authors appear to have taken due precautions against any possible misinterpretation, and there seems no doubt that these lines are actually due to the presence in the columbite residue of the elements 43 and 75.

As a result of this careful research work, the existence on the earth of the elements of atomic number 43 and 75 appears to be definitely established, a fact which is all the more interesting because certain writers have put forward arguments suggesting that a search for the eka-manganeses must prove fruitless. The actual amount of the new elements in columbite is estimated as from 10^{-6} to 10^{-7}, or somewhat less than the proportion indicated by the calculations outlined above. The chemical and physical properties appear to be closely related to those predicted by an examination of their neighbours, but no doubt more details will soon be available when greater quantities of the new elements have been isolated.

The authors suggest that the two newly discovered elements should be named Masurium (Ma) and Rhenium (Re) after the district of Eastern Prussia and after the Rhine respectively. Whether these names will meet with such widespread approval as the research itself remains to be seen.

Current Topics and Events.

IN celebration of the 250th anniversary of the foundation of the Royal Observatory, Greenwich, their Majesties the King and Queen will pay a visit to the Observatory on July 23. We understand that they will be received in the Octagon Room, the original Observatory, by members of the Board of Admiralty and of the Board of Visitors of the Royal Observatory, and will then be conducted over the buildings and shown the principal instruments. On the evening of the same day a conversazione is being given by the president and council of the Royal Society to meet the delegates to the International Astronomical Union. On the following day an official luncheon is being given, presided over by the First Lord of the Admiralty.

AFTER nearly two years' effort, the Australian National Research Council has succeeded in its project for establishing a Commonwealth School of Anthropology, to be attached to the University of Sydney. In December 1923 the Commonwealth Government expressed approval of a scheme submitted to it; in the following year, however, an officer selected by the British Government to advise Australia in the matter of administration of Territories, reported very strongly against the proposal to use such a school for the training of officials. In consequence, Government interest flagged. Renewed efforts, supported by the Australasian Association for the Advancement of Science and the universities, were made in September, and, largely as the result of a visit from Prof. Elliot Smith, who brought unofficial word of warm American sympathy, the Prime Minister promised to provide 1000*l.* per annum towards the expenses of a chair. The estimated yearly requirement being 2500*l.*, the respective States were then asked to contribute the balance of 1500*l.* between them on a population basis. New South Wales, Victoria, Queensland and Tasmania agreed to provide their shares, and South Australia is practically certain to fall into line; Western Australia remains uncertain. The Research Council, therefore, has now asked the Senate of the University of Sydney to consider the immediate appointment of a professor

and the general arrangements for the new school. In doing so, it has laid emphasis on the following points: (*a*) The main work of the chair both in teaching and research should be in the field of social anthropology rather than on the physical or anatomical side, though provision should be made for this also. (*b*) In view of the training of students for Government service in Papua and the Mandated Territories, and for specialised work in the Pacific, the professor chosen should have had actual field experience. (*c*) Though the routine work of the new chair will be under the control of the University of Sydney, it is urged that a permanent Advisory Committee, containing representatives of the Commonwealth, States and Research Council, should be appointed, to assist in the organisation of field research.

AN international conference is shortly to be held at The Hague on the subject of industrial property, that is to say, on patents, trade marks, and designs. It is a matter of considerable importance that Great Britain should be represented by delegates who have had wide experience in patent practice, but if the conference held in 1922 on the proposed Empire patent is to be taken as a precedent, it may be gravely doubted whether any such precaution will be taken. It will be remembered that at that conference the Comptroller was accompanied only by representatives of the clerical staff of the Patent Office, to the exclusion of representatives of the scientific staff who would have possessed both legal and technical training and experience. It is not surprising, in these circumstances, that the conference failed to produce any result, for the very delicate technical question arose of an Empire "search," or examination of all relevant British Empire patent specifications, before granting a patent, and none of the British representatives had that direct acquaintance with the "search" which might have enabled them to deal with this thorny problem in such a way as to satisfy the *amour propre* of the Dominion Governments. It would be far more serious, however, if Great Britain were to be unsuitably represented at an international conference, particularly if the Comptroller should be unable to attend in person. The effect of a given change in international patent practice cannot be instantly grasped by any one who lacks extensive experience of patents, and the interests of British manufacturers may inadvertently be prejudiced by negotiators who are not adequately qualified for their work. We trust that, on the occasion of the impending international conference, full use will be made of the technical knowledge and experience of the Patent Office staff.

THE Santa Barbara earthquakes at the end of last month prove to have been of less importance than the early accounts suggested. By the first, on June 29 at about 6.30 A.M. (2.30 P.M., G.M.T.), many buildings in Santa Barbara were destroyed or damaged (the loss being estimated at from three to six million pounds), twelve persons were killed, and water-mains were broken. The second, on June 30 at 1.22 A.M., is said to have equalled its predecessor in strength; while one of the after-shocks, on June 30 at 4.42 A.M., is described as severe. The area affected by the earthquakes was apparently small, and this seems to indicate that the depth of the foci was comparatively slight. In the neighbourhood of Santa Barbara there are several faults running east and west or parallel to the trend of the coast-line, and traversing longitudinally the Santa Inez and San Gabriel mountains. In the fault-map of California, issued by the Seismological Society of America, they are shown as inactive, but it would seem that they are rather in a state of moderate activity at long intervals. To one or more of these faults Dr. Bailey Willis attributes the group of strong earthquakes on November 27-30, 1852, and a local earthquake on July 30, 1902 (Bull. Seis. Soc. America, vol. 14, 1924, pp. 18-19). Between these shocks, on January 9, 1857, an earthquake, stronger than any of those mentioned above, was felt generally throughout southern California and severely in the Santa Barbara district. Dr. Willis assigns its origin to a movement along the extensive San Andreas fault, that with which the San Francisco earthquake of 1906 was connected.

A PRELIMINARY report on the Canadian earthquake of February 28 (NATURE, March 7, vol. 115, p. 347) has been issued by the seismologist of the Dominion Observatory (*Science*, vol. 61, 1925, p. 584). The epicentre of the earthquake is supposed to be in the mountainous region near the eastern boundary of the Laurentide Park. Its exact position is, however, at present unknown, the region being inaccessible when the first investigation of the central area was made. Many of the reports of the damage proved to be exaggerated or erroneous, but the amount was considerable at Quebec, Shawinigan Falls, Malbaie, St. Urbain, and the district near the Rivière Quelle. In every case of serious damage the ground was sand or clay, usually on the side of a hill, and the buildings were massive stone structures, without steel reinforcement, such as churches. A new seismograph station (the sixth in the Dominion) has been established by the Department of the Interior at Ste. Anne de la Pocatière, near the centre of the area affected by the earthquake of February 28.

JUNE established a record for its dryness, and almost a record for its duration of bright sunshine in England. At the Royal Observatory, Greenwich, according to the weather records published by the Registrar-General in the Weekly Return of Births and Deaths, rain fell only on two days, the measurements being 0·11 in. on June 24, and 0·01 in. on June 26, making a total of 0·12 in. for the month. The previous minimum rainfall at Greenwich in June since 1815, in 110 years, was in 1895 and was 0·21 in. The normal for 100 years to 1915 is 1·99 in., the normal for 35 years, 1881 to 1915, is 2·02 in., and the normal days with rain, 11. The smallest rainfall in any month of the year was in February 1821 and was 0·04 in., and in comparatively recent years, since 1900, the smallest monthly total was in April 1912 (0·07 in.), and in February 1921 (0·12 in.). There

was a drought from June 1 until 23. According to the weather correspondent of the *Times* (July 1), June 1925 was the driest June at Kew since records started in 1871, and also the sunniest. The total rain at Kew was 0·04 in. Ross-on-Wye, Calshot (near Southampton), and Falmouth are reported to have had no rain. The duration of bright sunshine at Greenwich was 251 hours, which averages 8·36 hours per day. In June 1914 the sun shone for 267 hours, which is 16 hours more than in June this year. The average duration in June for the 35 years 1881 to 1915 is 201 hours, 6·70 hours per day. The mean maximum shade temperature at Greenwich was 73°·1 F., which is 3°·1 above the normal, and the mean minimum was 49°·7 F., which is in precise agreement with the normal; the excess of heat was clearly due to the intense sunshine in the early part of the month.

WE learn from *Science* that Dr. E. L. Thorndike, professor of educational psychology in Teachers College, Columbia University, has been awarded the Butler gold medal, given every five years by Columbia University for the most distinguished contribution to philosophy or to educational theory, practice or administration, for his contribution to the general problem of the measurement of human faculty and to the application of such measures to education.

THE third annual corporate meeting of the Institution of Chemical Engineering is to be held in the Philosophical Hall, Leeds, on July 17. Afterwards a joint meeting will be held with the American Institute of Chemical Engineers, at which addresses will be delivered by the presidents of the two bodies, Sir Arthur Duckham and Dr. Charles L. Reese, and a symposium on "Industrial Water Supply and Stream Pollution" will be presented. Visits to Messrs. Nobel Industries, Ltd., Messrs. Jos. Crosfield and Sons, Ltd., and the United Alkali Co., Ltd., and to various places of interest in Scotland and England, have been arranged to follow the meeting.

MR. T. R. FERENS, of Hull, is well known for his generous gifts for educational purposes, culminating in a gift of 250,000*l.* for a university college at Hull, referred to in our issue of February 14, p. 230. He has now presented a sum of 20,000*l.* to the Medical School of the Middlesex Hospital for the foundation of an Institute of Otology. The new institute, which will occupy for the present a part of the top floor of premises in Cleveland Street, to which patients from the Middlesex Hospital are being removed during rebuilding of the Hospital, will be devoted to research on the structure, functions, and diseases of the ear, nose, and throat, and it is intended to establish a laboratory, museum, and library.

PROF. R. RUGGLES GATES, professor of botany, University of London (King's College), is sailing from Liverpool on July 14, by the S.S. *Hildebrand*, on an expedition to the Amazon region. He will leave the ship at Manaos and spend a month collecting plant materials in that region and farther down the river. Returning from Para, he will reach England early in October. Prof. Gates is taking Wardian cases to bring back living plants, and will also collect cytological and morphological material for research, as well as some dried specimens. He is also taking a photographic outfit, including a cinema camera and 3000 feet of film, and he expects to make some collections of plankton during the voyage and on the river.

THE control of the administration and the management of the Imperial Institute, South Kensington, has now been transferred, in accordance with the provisions of the Imperial Institute Act, 1925, from the Secretary of State for the Colonies to the Parliamentary Secretary, Department of Overseas Trade. The Imperial Mineral Resources Bureau was amalgamated with the Imperial Institute at the same time, and all correspondence relating to the work of the Bureau should be addressed to the Imperial Institute (Mineral Resources Department), South Kensington, London, S.W.7

AT the time of going to press (July 8), a reception is being held in the Pavilion of His Majesty's Government at the British Empire Exhibition, and invitations have been issued to view the Science Exhibition arranged by a committee of the Royal Society. The guests are being received by the president of the Royal Society, Sir Charles Sherrington, and the chairman of the Committee organising the exhibits, Mr. F. E. Smith. The Exhibition this year is a decided advance on that of last year, as will be seen from the account indicating some of its main features which appears elsewhere in this issue (p. 50). The Committee responsible for it is to be congratulated on the very representative collection of demonstrations and exhibits brought together. In connexion with the Science Exhibition, a volume entitled "Phases of Modern Science" has been prepared; this includes articles by leading authorities on various aspects of modern scientific research, and a descriptive catalogue of the exhibits. It constitutes a most valuable statement of the present position of physical and biological science. The section describing the exhibits is also being issued separately and is obtainable in the Government Pavilion at Wembley.

THE ninety-third annual meeting of the British Medical Association will be held at Bath on July 21-24, under the presidency of Dr. F. G. Thomson, physician at the Royal United Hospital, Bath. The annual representative meeting of the Association will be on July 17-20. The president will deliver his address and also open the annual exhibition of surgical appliances, foods, drugs, and books on July 21. Sir William Bragg is to deliver a popular lecture during the evening of July 24. The provisional sectional programmes include discussions on the following subjects, the opener's name appearing in brackets after the subject: Endocrine therapy (Dr. W. Langdon Brown and Prof. Swale Vincent), filter-passing viruses (Dr. W. E. Gye), pathological basis of treatment by radiation (Prof. S. Russ), pathology and bacteriology in Great Britain, with special reference to research (Prof. J. C. G. Ledingham), therapeutic value of light

(Prof. W. E. Dixon), food manipulation and health (Dr. W. G. Savage), influence of sunlight and artificial light on health (Prof. L. Hill), and the purity standard of milk (Dr. R. Stenhouse Williams, Dr. W. G. Savage, Dr. E. Pritchard, Mr. W. Buckley, Mr. G. P. Male and Mr. J. H. Maggs, each discussing a different aspect). The honorary local general secretary for the meeting is Mr. W. G. Mumford (British Medical Association Committee Rooms, Assembly Rooms, Bath); and the honorary assistant secretary is Dr. R. G. Gordon.

DR. ALÉS HRDLIČKA, of Washington, is now travelling through India on the first stage of a survey of the field of early man and his predecessors in southern Asia, Australia, and Africa, on behalf of the Smithsonian Institution and the Buffalo Society of Natural Science. In the course of a letter to the former body, he has some interesting observations to make on what he had seen up to the time of writing. Of the physical character of the people he says that the main elements are unquestionably Mediterranean and Semitic, but there are also indications of a Hamitic mixture. He had intended to visit Karachi to investigate the curly-haired people there, but considered this unnecessary, as he was informed that they were known to be of African importation, and that if there were any such natives they must be somewhere at the head of the Persian Gulf, a region now impracticable to reach. At Simla he saw people from the Tibetan borders and some few even from Tibet. Among the latter was one woman who looked a typical American Indian; her dress also strongly suggested the Indian.

THE hundredth annual report of the Bath Royal Literary and Scientific Institution records an earnest effort on the part of the members to revive its interest and usefulness. The ceiling paintings by Andrea Casali have been cleaned, the valuable collection of birds put into good order and the various rooms redecorated. The famous geological collection, containing 27 teeth of *Microlestes moorei* and 70,000 fish teeth from fissures of Rhætic age in the Carboniferous Limestone, is being re-arranged and relabelled as a memorial of the labours of Charles Moore, who did so much for the Museum and for geology. The winter series of lectures interrupted by the War were recommenced in 1921-2, and have steadily increased in number and interest until the accommodation is insufficient. A project for widening the adjoining roadway may result in the present building being taken down, in which case it is to be hoped that the Society may find itself provided with sufficient funds and vigour for the provision of a more suitable and better-placed museum in which the collections can be better displayed.

THE May issue of the *Scientific American* inaugurates a discussion as to whether street accidents due to careless driving would be diminished by the substitution of a regulation as to the distance in which a vehicle should be able to stop for the present speed limit. Mr. H. W. Slauson, who opens the discussion, is of opinion that they would, and points out that the object of the speed limit is to ensure that the driver shall have his vehicle under such control that he can stop quickly when called upon to do so. He may be under the speed limit, but his physical and mental condition and the state of his brakes may be such that he cannot stop quickly enough to avert an accident: under the speed limit regulation he is blameless. The fault lies with the regulating authority. Under a stopping-distance regulation, the duty of adjusting the speed to the condition of the driver and his vehicle would rest on the driver. Roads would be specified as "twenty feet," "fifty feet," etc., and the tests of vehicles would be simpler than the present speed tests.

THE Report of the Castle Museum, Norwich, for 1924, records a large number of gifts, and among them a fine series of mounted heads and horns of big game bequeathed by the late Mr. E. N. Buxton. To accommodate these, as well as the many previously in the Museum, it is proposed to extend the building over a portion of the inner garden. It has also proved necessary to extend the Skin Room over a vacant space enclosed by the outer wall of the Castle. A large collection of flint implements from various local sites, presented by Mr. H. H. Halls, has been drawn upon, with others, to provide a case illustrating neolithic culture in Norfolk and Suffolk. In many other directions, not so directly within our scope, this Report bears witness to a progress and activity of which Norwich should be proud.

SOCIETIES and Institutions in Great Britain, desiring to get into touch with similar bodies in Russia for the purpose of exchange or purchase of recent scientific publications, should address correspondence on the subject to one of the following organisations, in the hands of which the government of the U.S.S.R. has placed the responsibility for all arrangements of the kind. For all societies and institutions in Leningrad: The Publications Exchange Department, The Academy of Sciences, Leningrad. For all those in the whole of the rest of Russia, and for those in other constituent territories of the Union of Socialist Soviet Republics: The Book Exchange Bureau, The U.S.S.R. Society for Cultural Relations with Foreign Countries, Sverdlov Place, Moscow.

DR. C. A. CROMMELIN has published the inaugural lecture delivered by him on May 12 on the occasion of his taking up the post of lecturer in physics at the University of Leyden (Leyden: Edward Ijdo). As is well known, Dr. Crommelin has collaborated with Prof. Kamerlingh Onnes for many years in the conduct of the experimental researches carried out at the famous Physics Laboratory of Leyden. In all that relates to the science and art of measuring pressures, temperatures and volumes, he is one of the most experienced physicists in Europe, and now that Prof. Kamerlingh Onnes has retired, there is perhaps no one in the world who possesses the same knowledge of the intricate technique required in the measurements at low temperatures and high pressures which characterises so much of the work done at Leyden. In his address Dr. Crommelin has given a most interesting historical sketch of the development in the

making and using of instruments and apparatus in connexion with experimental research in physics. It is illustrated with portraits of three members of the celebrated van Musschenbrock family and is fully documented with literature references. For many years the laboratory of Kamerlingh Onnes has been a famous training school for young instrument makers and glass-blowers. Perhaps nowhere else in the world has so much attention been given to the development of this side of the work which is required in a great laboratory of experimental research in physics. It is therefore particularly appropriate that Dr. Crommelin should deal with this subject in his inaugural address, which can be heartily recommended to all who take an interest in the history of physical experimentation.

IN the Report of the Rhodesia Museum, Bulawayo, for 1924, the curator, Dr. G. Arnold, records the finding of several palæoliths from an ancient land surface now covered by 15-20 feet of flood-silt from the Umgusa River. He believes "that these implements, mostly of a Chellean and Acheulian facies, were fashioned by the predecessors and contemporaries of Broken Hill Man."

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: A part-time research demonstrator in mathematics at University College, Swansea—The Registrar, University College, Singleton Park, Swansea (July 15). Museum assistant and demonstrator in zoology at Birkbeck College—The Secretary, Birkbeck College, Fetter Lane, E.C.4 (July 21). Professor of electrotechnics in University of the Witwatersrand, Johannesburg—Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (July 31). Five appointments in the School of Dental Surgery, Cairo, namely, superintendent and lecturer in metallurgy and materia medica, lecturer in surgery and pathology, assistant lecturer in surgery and pathology, lecturer in mechanics and orthodontia, and a mechanic—The Under-Secretary of State, Ministry of Education, Cairo (August 14). Professor of organic chemistry and director of the chemistry department, Armstrong College, Newcastle-upon-Tyne—The Registrar (August 15). Director of the Rubber Research Institute in the Malay States—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, Westminster, S.W.1 (August 31). A reader in biology in the University of Hongkong—The Chief Medical Officer, Ministry of Health, Whitehall, S.W.1 (September 1). Professor of public health in the University of Edinburgh—The Secretary (September 15). Laboratory assistant for the Mobile Unit, Government Laboratory, Gold Coast—Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1.

Our Astronomical Column.

DISCOVERY OF A TENTH MAGNITUDE OBJECT.—A telegram from the International Astronomical Union Bureau, Copenhagen, announces the discovery of an object of the tenth magnitude. Its position on June 28 at $1^h\ 37{\cdot}0^m$ G.M.T. (new) was R.A. $0^h\ 23^m\ 28^s$, N. Decl. $0^\circ\ 41'$. Daily motion $+1^m\ 48^s$, N. $14'$. The motion is rather large for a minor planet, unless it should be of the Eros type.

M. Delporte apparently took the plate in the search for Tempel-Swift's periodic comet, using the ephemeris in the British Astronomical Association Handbook. However, as a later examination makes the probable date of perihelion March 1926 (see B.A.A. Journ., vol. 35, p. 150), the object is not likely to be identical with that comet. No further observations are to hand at the time of writing.

THE ROYAL OBSERVATORY, GREENWICH.—Dr. J. L. E. Dreyer contributes an article to the *Nineteenth Century* for July, which summarises the work done at Greenwich during the 250 years of its existence, and emphasises the vagueness of the knowledge of the heavens that existed at the time of its foundation. Tycho Brahe's star catalogue was then the best available, and the best lunar tables differed a quarter of a degree or more from the heavens. Flamsteed's observations of the moon were of great assistance to Newton for comparison with his gravitational theory. Dr. Dreyer vindicates Flamsteed against the charge of withholding these observations from Newton.

The splendid work of Bradley is given due prominence, credit being also given to Bessel and Auwers, who brought the results into a form that later astronomers could utilise. The development of the work of the Observatory under Airy and the further extensions made since his time are also described.

Dr. Dreyer is well known as an astronomical historian, and he has a congenial subject in dealing with the remarkable advance in knowledge since 1675, in which Greenwich has played a considerable part.

THE PHYSICAL STATE OF THE STARS.—While insisting on the incompleteness of the available observational material, Dr. A. Brill, in the *Zeitschrift für Physik* of March 21, attempts to deduce, on the basis of the Eddington theory, general regularities in the connexion between spectral type, surface temperature as deduced from colour and from energy distribution in the spectrum, absolute brightness, mass and other physical magnitudes for a very large number of dwarf and giant stars. It was found that the logarithm of K, Eddington's constant, which determines the mass absorption coefficient k in the interior of a star, only varies from 27·41 to 27·69 between the different spectral classes. $k\sqrt{\epsilon}$ is nearly constant for all stars, where ϵ is the energy radiated in unit time per gram. The following table, abridged from that in the original paper, gives some of the results obtained. Super giants are not considered.

Spectral Class.	Temp. °C	M(vis).	R. cm.	Mass. gm.	g cm./sec.^{2}	ρ gm/c.m.^{3}
DWARFS.						
O	$28{\cdot}7\times10^3$	−4·00	711×10^8	738×10^{33}	$9{\cdot}70\times10^3$	$4{\cdot}9\times10^{-8}$
B_0	21·4 ,,	−1·30	241 ,,	154 ,,	17·7 ,,	$2{\cdot}6\times10^{-1}$
A_0	11·8 ,,	+0·90	170 ,,	54·7 ,,	12·6 ,,	$2{\cdot}7\times10^{-1}$
F_0	7·76 ,,	+2·65	143 ,,	32·2 ,,	10·5 ,,	$2{\cdot}7\times10^{-1}$
G_0	6·32 ,,	+4·50	90·8 ,,	21·3 ,,	17·2 ,,	$6{\cdot}8\times10^{-1}$
K_0	5·23 ,,	+6·35	59·7 ,,	15·1 ,,	28·1 ,,	1·7
M_0	3·79 ,,	+11·00	19·2 ,,	6·89 ,,	124 ,,	23
GIANTS						
G_0	4·98 ,,	+0·25	1150 ,,	79·1 ,,	0·399 ,,	$1{\cdot}2\times10^{-8}$
K_0	4·57 ,,	+1·55	824 ,,	56·0 ,,	0·548 ,,	$2{\cdot}4\times10^{-8}$
K_5	3·62 ,,	+0·75	2550 ,,	99·5 ,,	0·102 ,,	$1{\cdot}4\times10^{-4}$
M_0	3·52 ,,	+0·25	3150 ,,	112 ,,	0·0757 ,,	$8{\cdot}7\times10^{-5}$

M(vis) is the visual absolute brightness in magnitudes, R the radius, g the gravitational acceleration at the surface, and ρ the density.

Research Items.

THE ETHNOLOGY OF THE FINNO-UGRIANS.—Dr. U. T. Sirelius has published through the Government Printing Office, Helsingfors, a study of the history, culture, linguistic and physical characters of the Finno-Ugrian peoples under the title "The Genealogy of the Finns." Although it is clear from the concluding chapter, which advocates political independence for those members of the group who have not already attained it, that the pamphlet is a piece of political propaganda, it is nevertheless a useful review of the evidence bearing upon Finno-Ugrian affinities and early history. No comprehensive survey of the physical characters of the Finno-Ugrians has been made, but such available data as are comparable indicate considerable divergence and show that they are no longer even approximately a homogeneous race. They fall into two main groups, one short, comprising Lapps, Ostyaks, and Voguls, all living near the Polar Circle, and a tall group to which belong all the other peoples, Hungarians, Baltic Finns, Volga Finns, and Permians. The Samoyeds, whose linguistic kinship to the Finns is now clear, resemble the members of the former group. In culture also there is a division between the Lapps, the Servenians of Archangel, the Voguls and Ostyaks, belonging to the north, who live by hunting, fishing, or reindeer breeding, and the remainder, who are tillers of the soil.

PERFORMANCE TESTS OF INTELLIGENCE.—Report No. 31 of the Industrial Fatigue Research Board, prepared by Miss Frances Gaw, describes performance tests of intelligence. Most of the well-known intelligence tests have a decided bias towards linguistic ability, and although for many activities of life language is a necessary medium, yet in dealing with some types, *e.g.* the deaf, the blind, it is necessary to find some other way of measuring intelligence. In the United States, owing to the large population of non-English-speaking foreigners, the study of performance tests has aroused much more interest than in England. This report discusses the need for them, their historical development, the principal scales and uses, and describes a series of performance tests. A comparison of these tests with other estimates of intelligence and with tests of mechanical and constructive ability is given, and there is a useful bibliography. All those interested in intelligence testing will find these tests a useful supplement to the usual ones, and particularly valuable in the case of those children who tend to express themselves in other than linguistic modes.

JAPANESE ALGÆ AND FUNGI.—Dr. Hans Molisch, professor of plant physiology in the University of Vienna, has been travelling for a considerable time in Japan, and Volume 1, No. 2, of the Science Reports of the Tôhoku Imperial University (Fourth Series), Biology, is composed entirely of various notes contributed by him upon his observations whilst in Japan. Dr. Molisch finds the same organism, *Bacterium phosphoreum* (Cohn), responsible for the development of luminosity in butcher's meat in Japan, if this flesh is kept standing in 3 per cent. sodium chloride solution, but not submerged in the solution. He describes curious fusiform bodies in a Japanese species of Vaucheria, which from their reactions appeared to be protein in nature. He records the occurrence of a parasitic Alga, *Mycoidea parasitica* Cunningham, upon leaves of Camellia, and of an epiphyllous Alga, *Phycopeltis epiphyton* Millardet, upon the leaves of various evergreens in Japan. *Pseudoplasmodium aurantiacum* Molisch is described and figured as the species of a new genus of Acrasieæ. Various fungi are described with the habit of growing in and feeding upon the waxy deposits on the cuticles of many species of grasses, of Acer, and of other trees. Some of these fungi were also grown in culture on beeswax. Prof. Molisch also supplies considerable data upon various organisms responsible for the deposition of hydrated oxides of iron in Japan, a subject on which he has already published a monograph based upon his European studies. He also records Nostoc colonies living apparently in symbiosis with two different liverworts, *Blasia pusilla*, L., and *Cavicularia densa*, St.

EFFECT OF THYROID FEEDING ON FOWL PLUMAGE.—Torrey and Horning (1922) reported that when dried thyroid was given to growing males these assumed hen-feathering. Crew and Huxley (1923), repeating this work, but with different material and methods, failed to obtain confirmatory results. However, it was noticed during the course of this work that the administration of thyroid was followed by a marked increase in the rate of plumage growth and replacement, and that in the birds used, Rhode Island Red (red ground with black areas) and Light Sussex (white ground with black areas), the birds receiving thyroid exhibited a pronounced tendency towards increased melanism, the black areas being markedly increased in size and intensity at the expense of the other colours. Since it is known that such a parti-coloured bird tends to become lighter as it ages, the suggestion presents itself that in senility the thyroid of the fowl becomes relatively less efficient in its functioning. Moreover, the observation that thyroid administration increased the rate of feathering in the growing chick and moulting adult gained in significance when Serebrowsky (1922), and more recently Warren (1925), showed that quick feathering as contrasted with slow is a typical sex-linked character. One who seeks to interpret genetic action in terms physiological is attracted by the notion that this sex-linked factor in its action determines the time during development when first the thyroid comes into action or the degree of the functioning of this gland. Cole and Reid (*Journ. Agric. Res.*, 29, 6, 285-287, 1924) also have recently repeated the work of Torrey and Horning and have obtained results which show beyond all doubt that thyroid administration does indeed affect the plumage characters of the male. They found that new feathers grown by the birds receiving desiccated thyroid showed distinct modification towards the female type of structure and colour and that the rate of growth of these new feathers was noticeably increased. There was a reduction of red pigment, the distribution of which was irregular, and also a reduction of that area of the feather in which the barbs lack barbules, the feathers of the hackle regions, instead of being pointed and elongate, coming to possess broad rounded ends closely resembling the feathers of these regions in the female.

THE GEOGRAPHICAL RANGE OF THE JURASSIC CRINOID PENTACRINUS.—The imperfection of the geological record is a conception that should constantly be applied to the distribution of extinct creatures no less than to their range in time. Many genera of crinoids, long known from only one country or one quarter of the globe, have of late been found to have a far wider, sometimes indeed a world-wide, distribution. Uintacrinus, Marsupites, and Saccocoma have yielded instances. These, it happens, are all

unstalked forms and if, as some suppose, they were members of the plankton, then their wide distribution is readily explained. The latest case, however, is that of a very much-stalked form. The species *Pentacrinus subangularis*, recorded from the Middle and Upper Lias of Europe, has now been found in Alaska. Dr. Frank Springer (Proc. U.S. National Museum, 67, Art. 5) also regards as very close relations some columnals previously known from Dakota and Utah and some lately described by himself from Roti in the Dutch East Indies. This range, he says, far exceeds that of any crinoid of the present ocean. "The deep and clear seas prevailing in the Jurassic and Cretaceous periods were," he thinks, "favourable to the development and spread of marine faunas over large areas with a minimum of checks and interference, in contrast to those of subsequent periods down to the present, in which owing to the great changes in land form affecting the conditions of marine life, and to increasing competition arising from the multiplication of forms, the tendency has been toward progressively greater restriction of faunal areas." This may be, but in this connexion one may recall the many specimens of *Pentacrinus fossilis* attached to logs of wood, and may surmise that *P. subangularis* also belonged to the pseudo-plankton in its young stages. In spite of its wide distribution and its great abundance of individuals, the genus Pentacrinus did not, so far as we know, survive into Cretaceous times.

THE RANGE OF OTHER FOSSIL CRINOIDS.—Another instance of a wider distribution than had been supposed is afforded by the genus Apiocrinus. This crinoid, of which the Bradford or pear encrinite is the best-known example, is not uncommon in the Jurassic rocks of Europe, but has not hitherto been recorded from America. In the Proceedings of the United States National Museum (vol. 67, Art. 18, 1925) Dr. Frank Springer now describes some columnals from rocks, probably of Upper Jurassic age, on the isthmus of Tehuantepec, Mexico, and refers them to this genus as a new species, *A. tehuantepec*. It is also a genus long known only from Europe; at least it was not generally recognised that the Cainozoic form of it was represented in New Zealand. Recently, species of this form have been identified from various other regions of the Western Hemisphere, so that it rivals Pentacrinus in its distribution although so much later in time. This does not quite substantiate the contrast drawn by Dr. Springer. It is still unsafe to base conclusions upon our ignorance. For example, the fossil comatulids, of which so many species are known from Europe, appear as yet to be represented in America only by the rather obscure Microcrinus of Emmons; no doubt they also will be found.

SEISMIC WAVES.—The March issue of the *Journal de Physique* contains the results of the observations of the earth and air waves produced by the destruction of melinite on four dates in May 1924 at the camp of La Courtine in the centre of France. The earth waves were observed by MM. C. Maurain, L. Eble and H. Labrouste by the aid of seismographs recording the vertical, horizontal transverse and horizontal longitudinal movements of the ground at three stations between 5·5 and 25 kilometres from the point of explosion. The waves most rapidly propagated affect the vertical and longitudinal instruments only and travel with a mean speed of 5·52 kilometres per second; the slower or long waves affect all three instruments and travel with a mean speed of 2·80 kilometres per second. At the station nearest to the explosion a further slight transverse wave of speed 4 kilometres per second was observed. At Meudon, 340 kilometres from La Courtine, MM. A. Perot and F. Baldet observed the arrival of the air wave by means of a drum closed by a paper diaphragm and a sensitive flame, and found the mean speed of propagation to be 341·7 metres per second at 16° C., the first effect being a decrease of pressure of 0·6 millimetres of mercury followed by an equal increase.

THE NILE AND ITS FLOODS.—In "A Short Account of the Nile and its Basin," Dr. H. E. Hurst has published a paper he read to the International Congress of Geography (Cairo, 1925), which contains a useful summary of the latest data, accompanied by a large scale map, with regard to the Nile floods. The Nile water supply comes from two sources, first the tributaries rising in Abyssinia, and secondly, the water from the Lake Plateau of East Africa. Very little water from the Sudan reaches the Nile, since it is largely evaporated where it falls. During September, when the water is highest in the main Nile, the Blue Nile contributes 72 per cent., the Atbara 15 per cent., and the White Nile 13 per cent. During the low stage of the main Nile the White Nile supplies 80 per cent. of the water. The White Nile is at its maximum discharge in October, its waters having been held back from July to September by the rapid rise of the Blue Nile. The White Nile water comes from two sources, the Sobat and the Bahr el Gebel and Bahr el Zeraf. Very little is known of the details of the regime of the Sobat, but its maximum discharge is in October and November, while the maximum of the Abyssinian tributaries is in September. The Bahr el Ghazal, in spite of its large basin with a good rainfall, contributes very little water to the Nile. Practically all the discharge of the Gebel and Zerat comes from the Great Lakes and the plateau, but fully half that enters the swamps of the Gebel is lost. The regime of the lakes is not well known.

SURFACE DAY VISIBILITY.—The Meteorological Office, Air Ministry, in Prof. Notes, Vol. 3, No. 40 (H.M. Stationery Office, Price 3*d*.), has issued a discussion on the ground day visibility at Cranwell, Lincolnshire, during the period April 1, 1920–December 31, 1923, by Mr. W. H. Pick. The relationship dealt with is that existing between ground visibility and the surface wind direction, the surface wind velocity, the existing pressure type, and the presence or absence of convection currents. For the Cranwell area it is concluded that bad or poor visibility is most frequent with wind calm or from about south-east, while good or very good visibility is most frequent with winds from north-eastward or southward. Winds with a greater velocity than 15 m./hr. are seldom accompanied by bad or poor day visibility. Days with convection, taken as days with cumulus or cumulo-nimbus cloud, are likely to be accompanied by good or very good visibility. It is regrettable that, when referring to weather types, numerals only are given, being those affixed by Col. Gold in his "Aids to Forecasting," Geophysical Memoirs, Vol. 11, No. 10. The communication in this respect is comparatively valueless unless the reader has the M.O. publication referred to. In a discussion on similar lines, Prof. Notes, Vol. 3, No. 37, noticed in NATURE, December 6, 1924, p. 838, dealing with pressure type in relation to fog frequency at Scilly during summer months, specimens were given of the different types of weather with which the author was concerned; economy in printing has possibly caused the omission.

A WIDE-ANGLE (180°) LENS.—A compound lens that enables one to photograph the entire inner surface of a hemisphere at one exposure is described by Mr. Conrad Beck in an article in the

Journal of Scientific Instruments, vol. 2, No. 4, 1925. The principle of the method occurred to Mr. W. N. Bond and to Mr. Robin Hill independently, and is that of the view which is obtained of the sky from under water, the "fish's view." Mr. Hill has devised the apparatus, which consists of a large front lens of 2¼ inches diameter, with a curved convex outer surface. At this surface a view angle of 180° is contracted to a cone of about 90°. The inside surface of this lens is very deeply concave, and of such a curve that the central ray from each point of the view passes through it with scarcely any deviation. Close to the apex of the light-cone thus formed is a comparatively small photographic lens. The combination gives an image of the complete hemisphere on a flat disc about 2½ inches diameter, and with an aperture of f/22 good definition is obtained over the whole area. The character of the distortion of the image is described, and an undistorted image of any part of the photograph is obtained by reversing the action of the apparatus so that the lens is used to produce the projected image. The description is illustrated by 5 photographs of the sky, one of the nave of Ely Cathedral, and enlargements from a part of the last and one of the skies. The enlargement of the Cathedral clearly demonstrates the elimination of the distortion.

X-RAY ANALYSIS OF SOLID NITROUS OXIDE AND CARBON DIOXIDE.—It is noteworthy that the Laboratory of Physics and Physical Chemistry of the Veterinary College at Utrecht, in which van 't Hoff held his first appointment at the time when he enunciated his new theory of "Chemistry in Space," is now producing, under the direction of Prof. N. H. Kolkmeijer, an important series of investigations of space-structure by the modern method of X-ray analysis. It was natural that one of the first cases studied in a laboratory so close to that of Prof. Cohen should have been that of white and grey tin, with the result that grey tin was shown by Kolkmeijer and Bijl in 1918 to have the familiar lattice-structure of the diamond. A more recent paper, reprinted from the Proceedings of the Amsterdam Academy, describes the crystal structure of solid nitrous oxide and carbon dioxide. Each substance has a cubic symmetry, the side of the cube containing four molecules of N_2O being 5·72 Å.U., whilst that which contains four molecules of CO_2 is 5·63 Å.U. The distance between two neighbouring atoms is given as 1·15 Å.U. in N_2O and 1·05 Å.U. for CO_2. Another paper records the fact that black precipitated mercuric sulphide, although often described as "amorphous," crystallises in the cubic system and has a structure similar to that of the cubic form of zinc sulphide.

THE SPECTRA OF ISOTOPES.—In the issue of the *Physikalische Zeitschrift* for May 25, Dr. G. Joos, of Jena, summarises the present state of our knowledge of the influence of isotopes on spectra. Up to now trustworthy evidence of such influence has only been furnished in the case of band spectra, in which both the oscillations and rotations of the nucleus are slowed down for the heavier isotopes, as, for example, in the well-known case of the hydrogen chloride doublets. In other cases the observed change of frequency has been used to determine the constitution of the nucleus the movements of which produce the spectral line, and the hydride of the metal concerned has frequently been found to be the effective material. So far, the influence of isotopes on line spectra has only been found in the case of lead, and it appears to be due to some difference of the structure of the nucleus. No direct connexion between the satellites of spectral lines and the isotopes of the material appears to exist.

THE CONTINUOUS SPECTRA OF THE HALOGENS.—After considering the different conditions under which the continuous spectra of iodine vapour and of bromine and chlorine are observed, Dr. W. Steubing has come to the conclusion that they are not of molecular but of atomic origin, though they are not connected with the normal atomic line spectra of the elements (*Zeitschrift für Physik*, May 5). For the production of line spectra, accurately defined orbits with definite energy values are necessary; monochromatic emission will not occur when electron jumps take place which cannot be ascribed to a definite quantum orbit, but the emission will be governed by the laws of chance. It has been shown by the author that the outer electron layer, in the case of the halogens, is very unstable when acted on by magnetic and electric fields, and it is considered probable that it is also unstable for mechanical shocks; a single electron of a broken-up layer will, at first, have no uniquely defined energy, and will only attain this when the layer is completed. Thus the emission will not be monochromatic, but it will lie between certain limits having a definite boundary on the long wave-length side, as is actually observed in these three spectra. Other gases and vapours which emit a continuous spectrum do not exhibit a definite boundary towards the red.

HYDROGEN-NITROGEN AND LIQUID AMMONIA EQUILIBRIUM.—The volume percentages of ammonia in a compressed hydrogen-nitrogen mixture over liquid ammonia have been measured by A. T. Larson and C. A. Black, who record their results in the April issue of the Journal of the American Chemical Society. A true equilibrium appears to exist. The temperature interval used was −22·5° to 18° and the pressure range 50 to 1000 atm. The volume percentages increase with increasing temperature and decreasing pressure; the values are much higher than those calculated from the vapour pressure of liquid ammonia.

QUENCHED CARBON STEELS.—A valuable little paper on "The Structure of Quenched Carbon Steels" was presented at the recent meeting of the Iron and Steel Institute by B. D. Enlund, of Sweden. He has carried out measurements in order to determine the influence of annealing on the electrical resistivity and the specific volume of quenched carbon steels. All the curves show two bends, one appearing at a temperature of 110-120° C. and the other at about 250-260° C., according as the carbon content of the steel is high or low. These bends are visible in all the curves, thus indicating that the same reactions occur in all the steels The bends consist in all cases of deviations towards the temperature axis, which indicates that a precipitation of cementite takes place at the temperatures mentioned. As is well known, a reaction of this kind is always accompanied by an increase in electrical conductivity. From a knowledge of the phenomena occurring in high-carbon steels quenched from a high temperature, it may thus be concluded that the break in the curves at about 110° is caused by the transformation of martensite into troostite, and the second by the resolution of austenite into α iron and cementite. Though very slight, the second bend in the curves of the mild steels is quite distinct, and it is thus evident that even such steels contain γ iron representing untransformed austenite. This is a very interesting and valuable conclusion to have established. The formation of troostite at 110° C. is accompanied by a contraction, whereas the precipitation of α iron and cementite at 250° C. causes an expansion.

The National Physical Laboratory, Teddington.

ANNUAL VISITATION.

ON Tuesday, June 23, the annual visitation by the General Board of the National Physical Laboratory took place. In accordance with custom a number of members of scientific and technical societies and institutions, government departments and industrial organisations, were also invited to the Laboratory, which was open for inspection. The visitors were received in the new Aerodynamics Building by Sir Charles Sherrington, president of the Royal Society and chairman of the General Board, Sir Arthur Schuster, and the Director of the Laboratory, Sir Joseph Petavel. Prior to the visitation the new entrance to the Laboratory, in Queen's Road, was formally opened by Sir Charles Sherrington.

Referring to the general development of the Laboratory, Sir Charles remarked that it is now twenty-five years since the Laboratory came into being, and in that period it has come to occupy an all-important place in the national organisation for the advancement of science. This rapid growth is a testimony of the energy and ability of the first Director, Sir Richard Glazebrook. With the further expansion under his successor, Sir Joseph Petavel, arose the demand for new roadways. Their construction was begun in 1922, and the projected development included the improvement of the approaches to existing buildings and the reconstruction of the entrance from Queen's Road. It is gratifying that the new roads have been named Kelvin Avenue and Rayleigh Avenue. The service which the late Lord Rayleigh rendered to this institution cannot be overstated, and forms an abiding part of its high tradition.

An extensive series of exhibits had been arranged to illustrate the general character of the work of the Laboratory.

In one of the seven-foot wind channels in the Aerodynamics Department was a model for investigating the performance of the autogyro, a machine representing an innovation in aeroplane design. This machine differs from the orthodox type in that it has no wings, their place being taken by an airscrew on an axis which is nearly vertical. The machine is equipped with a motor and propeller as usual, and the motion of the air past the vertical screw as the machine gathers speed causes it to rotate and to lift the machine from the ground. It is claimed by the inventor of this machine (which is being developed in Spain) that an almost vertical landing is possible and that it will not stall.

In the four-foot wind channel was exhibited an apparatus for investigating rapid fluctuations of wind velocity, such as occur in the eddy region behind an obstacle placed in the channel. Owing to lag, ordinary anemometers cannot follow these variations, and the possibility of using hot wire anemometers for the purpose is being explored. A hot platinum wire forms one arm of a Wheatstone's bridge, and changes in wind velocity affect its resistance, disturbing the balance of the bridge. The corresponding variations in the current are shown by an Einthoven galvanometer. With the finest platinum wire one-thousandth of an inch in diameter, fluctuations of 2 or 3 per second are faithfully recorded.

In the Engineering Department an interesting exhibit was an instrument for recording the vibrations of structures. In this an arm carrying a small stylus is so pivoted on a frame that it responds to very minute vibrations of the frame. Supported by means of springs is a system possessing large inertia compared with the vibrating portion and carrying a smoked glass plate, on which the vibrations of the stylus are recorded. The stylus magnifies the vibrations twenty times, and a further magnification of fifty times is obtained by optical projection. A testing machine for big-end bearings of petrol engines was also shown. This work has been undertaken in connexion with the development of high-power light-weight internal combustion engines.

Other exhibits included apparatus for investigating the impact strength of chains and for examining the stress set up in pipe sockets due to caulking. In this connexion it has been shown that for some time after caulking there is a definite slow reduction in caulking stress, indicated by a gradual reduction of the outside diameter of the socket.

The Department of Metallurgy and Chemistry displayed specimens of light alloys which had been treated for the removal of occluded gases. One of the defects of aluminium alloy cast in sand is "pinholing" due to the presence of these gases, the degree of occlusion of which is affected by the rate of solidification. If the alloy is cast in a metal mould, solidification is rapid and the gases are retained in solution.

There were also shown examples of the pure metals manganese, chromium, and iron, prepared in the Laboratory. Pure iron and chromium are produced by electrolysis from an aqueous solution of their salts. Pure manganese is prepared by distillation from the commercially pure mineral in a high-frequency induction furnace in vacuum, which is also used in the preparation of pure alloys of these materials. Special refractory crucibles made from pure magnesia and alumina were produced for this purpose. A further exhibit showed beryllium obtained by the electrolysis of fused beryllium salts. The metal has a high degree of purity and is produced by slowly withdrawing the cathode, thus forming a rod which is afterwards melted in the induction furnace already mentioned.

The Chemistry Section displayed apparatus for determining the viscosity of molten glass. The glass is contained in a platinum crucible in an electric furnace, and is withdrawn adhering to a fine platinum wire moving at a definite rate, the temperature of the furnace being observed with an optical pyrometer. The viscosity is obtained from the weight of glass adhering to the wire.

In the William Froude National Tank there was shown the apparatus for the investigation of the movements of a lifeboat on a slip-way during launching. As the boat traverses the slip-way, the progress of its bow and stern are recorded electrically after each fall of 6 inches. The conditions under which the tests are being conducted include varying slip declivity and friction, smooth and stormy water, and different states of the tide. An exhibit of popular interest was a wax model of H.M.S. *Victory*. This was ballasted and towed from the travelling carriage of the tank so as to simulate the course which a sailing ship would take under sail, and its leeway could be measured. The apparatus for determining the resistance and running angle of flying boat hulls in motion prior to taking off was also shown.

In the Metrology Department were a number of exhibits dealing with high precision measurements, and comprising standards and measurements of mass and length, measurements of volume, and the testing of hydrometers, barometers, and chronometers.

Another exhibit was a new form of cadmium lamp

recently invented by M. Hamy which contains no internal electrodes. It is stated that the spectrum from this is identical with that from the Michelson cadmium lamp, which in the past has been used for experiments on the use of a wave-length of light as a fundamental unit of length. The comparison of a 6-in. and a 30-in. Fabry-Perot étalon illustrated how, by stepping up, lengths of the order of a metre and over can be measured accurately in terms of the ultimate unit.

The apparatus for silvering the plates used in interferometry methods of measurement was shown. The glass plate forms the anode of a vacuum vessel, and the cathode, of silver, is hung above it. The silver film is deposited on to the plate by the passage of an electric discharge. Films from 1 to 2 millionths of an inch in thickness can be obtained by this method.

In the workshop was a machine for facilitating the accurate lapping of pivots. In this the work in progress is magnified by projection, and the operator can compare the magnified image with an outline drawing, on the same scale, of the required profile.

The Physics Department was responsible for a large number of exhibits. Among them was an apparatus for the determination of the effect of humidity on the mobility of ions. A heated platinum wire mounted in an insulated metal tube is used for the production of the ions, which are drawn to the outer tube by the application of an electric field, the thermionic current being measured in the usual manner by means of an electrometer. The experiments are conducted at atmospheric pressure, and the humidity of the air surrounding the heated filaments can be adjusted. Another interesting exhibit was an apparatus for the determination of the heat loss from bare pipes. A graphite rod extending from end to end of a long iron pipe is heated electrically and the energy dissipated in it is measured. The corresponding temperatures at various points along the pipe are measured by thermocouples.

In the Sound Section was an apparatus for the photographing of sound waves. The passage of an electric spark across a short gap produces a single spherical sound pulse, the shadow of which is afterwards photographed under the illumination of a second spark. By using this apparatus in conjunction with sectional models of buildings, the acoustic properties of the latter can be determined.

The purity of the sounds produced by electrical apparatus used in acoustical work depends upon the wave-form of the electrical oscillations. A cathode ray oscillograph for the study of the latter was shown, the spot describing a circle on the fluorescent screen when the oscillations are sinusoidal.

Among the exhibits of the Radiology Section were Laue photographs of diamonds used as pivot bearings In this connexion it has been found that the direction of the cleavage plane of the diamond with reference to the bearing surface is of great importance.

In the Optics Section were shown a flicker photometer for heterochromatic photometry and a spectrophotometric equipment using unpolarised light. In the latter, the absorbing optical parts are reduced to a minimum and measurements are made by a Lummer-Brodhun contrast field. As a result the instrument is very efficient at low illuminations. It possesses two collimators, and the light from the two sources is brought to approximate equality by means of rotating sector discs, the final balance being obtained by means of a wedge in the path of one of the beams.

In the Electrotechnics Department, Alternating Current Division, a recently constructed power-measuring apparatus was on view, including a precision electrostatic wattmeter. Another exhibit consisted of the calibration of a 10,000 kilowatt 3-phase wattmeter operating at 6600 volts. This calibration is carried out by the employment of a fictitious load method in which the pressure and current coils are separately excited. In the Direct Current Division was shown a 5000 volt direct current set, for tests on equipment connected with railway electrification. In particular, it has been used for the testing of impregnated timber designed to protect railway workers from shock through accidental contact with the live rail.

The exhibits of the Photometry Division included the apparatus for the standardisation of electric incandescent lamps in terms of the international candle and for the measurement of mean spherical candle power. In the experimental illumination building, demonstrations of the use of the daylight-factor meter—an instrument for the direct measurement of the proportions of the total external daylight reaching various points in a room—were in progress.

In the Wireless Division was an oscillograph used for analysing the wave-form of a valve oscillator and amplifier. A condenser in the grid circuit of an oscillator discharges linearly through a diode, and the discharge can be synchronised with the oscillations to be measured. The actual wave-form is traced out by the spot on the fluorescent screen of a cathode ray oscillograph. Another interesting feature was an apparatus for the measurement of the intensity of the field from a distant radio transmitting station.

A number of piezo-electric quartz resonators and oscillators for the purpose of radio frequency standardisation were shown in the Electrical Measurements and Standards Department. These oscillators form extremely constant sources of radio frequencies and are capable of controlling the output of valve generators. Another exhibit was a standard sonometer for the measurement of audio frequencies. The apparatus is very simple in principle. It consists of a phosphor-bronze wire loaded with a heavy weight. The wire passes between the poles of an electro-magnet and carries the current the frequency of which is under measurement. A sliding bridge with rack and pinion enables the free frequency of the wire to be brought into synchronism with that of the source. A pointer indicates the frequency directly. Various scales corresponding to modes of vibration in one, two, three, five, and ten loops, are used. The total range is from 100 to 10,000 cycles per second, with an accuracy throughout of 1 in 1000.

Glacier Lassitude.

ON the Mount Everest Expedition, 1924, a peculiar condition of prostration and lassitude was experienced by its members whilst crossing ice under certain conditions. The appearance of this fatigue was found to coincide with the presence of a hot sun and a still air: this combination of conditions led to a saturation of the stratum of air on the glacier with moisture, so that the loss of heat from the body was interfered with. The effect was not due to altitude alone, since the lassitude disappeared the moment the observers left the glacier, and was not experienced in the early morning or late evening.

The explanation of this effect given by Major Hingston has been confirmed by some experiments undertaken by Leonard Hill and A. Campbell (*Lancet*, 1925, vol. i. p. 939). The authors examined the

effects of work with the bicycle ergometer in ordinary atmospheric air (21 per cent. oxygen) with a dry bulb temperature of 20° C. and a low cooling power, and with a temperature of about 8° C. and a high cooling power, and compared them with those produced by similar temperatures when the air breathed contained only 11-13 per cent. of oxygen: this level of oxygen was sufficiently low to produce symptoms of deficiency of oxygen in the experimental subject, such as weakness, giddiness, and cyanosis. It was found that an atmosphere with a low cooling power, or one with a lowered oxygen content, increased the pulse-rate more than one with a higher cooling power or a normal oxygen content: the effect of cooling power was observed whether the atmosphere contained a low or a normal amount of oxygen, while the effect of variation in the oxygen supply was seen independently of the cooling power of the atmosphere. When the two more disadvantageous conditions were combined in one experiment, that is, a lowered percentage of oxygen in the air breathed together with a low cooling power of this atmosphere, the increase in the pulse-rate was about equal to the increase due to the anoxæmia plus that due to the low cooling power. In the two subjects examined, the increase due to these two factors combined was about 24 and 36 beats per minute respectively: and at the same time the symptoms of anoxæmia and discomfort were more marked under warm conditions with a low oxygen tension. It was also found that there was no hindrance to the passage of oxygen across the pulmonary epithelium when air with a low oxygen tension but saturated with moisture was breathed, so that the results observed appear to be due to the two factors of overheating of the body and of breathing oxygen at low tension. The pulse-rate alone is a guide to the distress of the heart under these conditions.

An obvious means of counteracting the effects of altitude is to increase the oxygen in the air breathed by a supply from some form of apparatus, but in the last expedition this method was found to be of little benefit. Hill and Campbell make the following suggestions to account for this finding. The observers have been in an atmosphere containing a low oxygen tension for a considerable time, and the effects of enriching this atmosphere with oxygen may be different from those observed in unacclimatised subjects submitted to acute anoxæmia for short periods. A further factor is the difficulty of obtaining the full amount of oxygen given by the apparatus, some being almost inevitably wasted, without the wearing of a face-piece. Finally, the authors lay stress on the oxygen dissolved in the plasma in distinction from that in combination with the hæmoglobin in the corpuscles. It is of course the dissolved gas which is immediately available for the tissues, and the amount of this depends on the tension of the gas in the alveoli of the lung. Breathing air containing 30 per cent. oxygen at 29,000 feet would give only about 60 mm. mercury tension of this gas in the alveolar air. Although this would saturate the hæmoglobin to 90 per cent., the amount of gas dissolved in the plasma would be only about two-thirds of that normally present when ordinary atmospheric air is breathed, so that the supply available for the tissues would still be distinctly subnormal.

The Middle Carboniferous of the North of England.

MR. W. S. BISAT'S paper on "The Carboniferous Goniatites of the North of England and their Zones" (Proc. Yorks. Geol. Soc., N.S. vol. 20, 1924, pp. 40-124 and Pl. I.-X.) must take rank as one of the classics of Carboniferous stratigraphy. It provides the first clear guide to the "no man's land" of grits and shales which lie between the Carboniferous Limestone and the coal measures, while it will also be of the greatest value in the correlation of the Coal Measures themselves by providing a sure base from which to work.

The Goniatite succession is traced from the upper Viséan to the base of the Upper Coal Measures (of Lancs. and Yorks.). Zones D3 and P (the latter characterised by *Goniatites s.s.*) are retained in the Viséan. They are represented by the "knoll" limestones and the Bowland shales, which are regarded as in part contemporaneous. For the overlying beds, up to and including part of the Lower Coal Measures, the term Lancastrian is introduced. These beds are divided into the zones of Eumorphoceras (E), Homoceras (H), Reticuloceras (R) and Gastrioceras (G) in ascending order. Hinde's Pendleside group (=Bowland shales) is found to be substantially equivalent to the Yoredales in age, and it is therefore proposed to discard the term, retaining Bowland shales as a facies name. The group belongs partly to P (Viséan) and partly to E (Lancastrian). The Yoredales of Derbyshire belong mainly to a higher horizon (upper E and H), corresponding to the Sabden shales of the Pendle area, while the overlying Kinderscout grit and shale is referred to R, leaving the upper portion of zone R together with zone G for the higher grits and part of the Lower Coal Measures. The major (generic) zones named above are divided into minor (species) zones, of which twenty-one are recognised. Local details of the zonal determinations are given somewhat fully for south Yorkshire and Lancashire, with more brief reference to other areas.

The value of the stratigraphical portion of the paper is dependent on the full study of Goniatite palæontology on which it is based, and which forms the second (and larger) section. This constitutes a monograph on the family and one only regrets that it is not in more definitely monographic form. In its present relations, it is naturally concerned mainly with the diagnostic characters of species and varieties, and has less emphasis on their mutual relations and general evolution, though the section commences with an excellent key to the genera. The ontogenetic history is found to be strikingly uniform throughout the family, especially in regard to sutures, but with the usual independence in the rate of development of the several characters. Fifteen genera (four new) and fifty-six species (thirteen new) are described. The largest number belong to the zones D, P, E, and H, below the Kinderscout grit. Above that horizon only Reticuloceras (in the grits) and Gastrioceras (in the upper grits and Lower Coal Measures) appear to occur. A noteworthy feature is that the sutural development is at its maximum in the earliest zones, the species which follow being evidently katagenetic in this respect. The history of the other characters is less obvious, but the striking reduction in the number of species and the variability of the later forms seem to confirm a general decadence of the family. All those interested in Carboniferous stratigraphy will look forward with the highest interest to the further extension of Mr. Bisat's work.

The same part of the Yorkshire Geological Society's Proceedings contains a valuable résumé by Mr. G. W. Lamplugh of our present knowledge of the Speeton clays (the presidential address) as well as other important contributions.

Societies and Academies.

LONDON.

Optical Society, May 14.—F. W. **Preston**: (1) The fundamental law of annealing. The fundamental law of annealing, that the rate of decrease of stress varies as the square of the stress present, is deduced from first principles by means of dimensional analysis, assuming that the rate of decrease of stress depends, (1) only on the stress present and the viscosity; (2) on the stress present, the viscosity, and the rigidity of the material. The law suggested as an empirical relation by Adams and Williamson is true dimensionally.—(2) The dimensional accuracy of Mr. Hampton's paper on "The Annealing of Glass." No corrections are made in Mr. Hampton's results, which are based on sound reasoning. The practical conclusions of Mr. Hampton's paper are justified in every way.—T. **Smith**: Note on the cosine law. Objections raised to the statement that rays selected by a cosine relation determine caustic surfaces in the object and image spaces, and to some points in the proof of the cosine law, are considered, and the adoption of the original enunciation of the theorem justified as opposed to the modified form suggested by Hertzberger and approved by Boegehold. A direct derivation of the analytical form of the law of refraction from the cosine law is given.

Royal Statistical Society, May 19.—Sir Napier **Shaw**: Week or month as an intermediate time-unit for statistics. In agriculture the week is generally recognised, but the month often exerts a certain dominance; in finance the year is the chief unit and next to that the week; for meteorology the calendar month is dominant and the week is only used at present for special purposes such as correlation with agriculture or hygiene; for railway statistics the calendar month and year again are dominant; for social statistics (Poor Law, etc.), the week is the favourite unit; for trade and shipping the month is used exclusively, whereas the week and corresponding quarters are the bases of vital statistics in the majority of countries; Brazil, Bulgaria, Hungary and Italy, however, use the month for that purpose. Starting from the conclusions: (1) that the original purpose of the month to keep in touch with the phases of the moon has not been successful, (2) that the division of the year into twelve unequal parts is not a fundamental principle of statistical science, (3) that a period shorter than a month is necessary for various reasons of correlation, and (4) that there is no possibility of using monthly data in connexion with weekly data or vice versa; a suggestion is put forward for placing statistical data upon a basis of weeks or groups of weeks with an adjustment to the calendar year. The grouping of the fifty-two weeks of the year into thirteen groups of four weeks each, or four groups of thirteen weeks each, is left open. For general climatic purposes a quarterly arrangement with judicious selection of the quarters might be sufficient.

Geological Society, May 20.—H. **Dewey**: Palæolithic implements of Chellean type found in the gravel of Hyde Park, London. The implements were collected from gravel thrown out of a deep trench of length 44 feet, breadth 14 feet, depth 40 feet. The London clay has been exposed at the northern end of the excavation, but falls suddenly at the southern end to an unknown depth. The gravel therefore covers a step-like fracture, which curves round from west and east to north-east. The stones are principally Chalk-flints. The implements were all from a depth of 26 feet. They include one hand-axe of Chellean type; the topmost portion of a second hand-axe; two choppers worked along the edges so as to provide a comfortable hold; two long flakes or flake-scrapers; a broad flake or grattoir; and some pieces showing a certain amount of human workmanship.—J. W. **Tutcher** and A. E. **Trueman**: The Liassic rocks of the Radstock District (Somerset). These rocks are unusually interesting, because in some divisions they are very thin; the total thickness of Lias does not exceed 200 feet, and is often much less. The succession of rocks has been worked out. An unusual number of ammonite faunas are richly represented, often in remanié deposits. Deposition of White Lias occurred during a time of fairly uniform subsidence, and was followed by folding along east-and-west axes, and denudations of the anticlinal areas. Deposition was renewed and followed by uplift in the south and denudation of much of the clay there. Then came deposition of the Obtusum nodule-bed and of the Raricostatum clay, and afterwards renewed uplift in the south and denudation. Further deposition included the Armatum bed in the south only, a remanié bed; the Jamesoni limestone, fairly uniformly; and the Striatum and Capricornum clays.

EDINBURGH.

Royal Society, May 25.—John **Thomson**: Parasitism of *Cuscuta reflexa* (Roxb.). The hyphæ or modified root-hairs are differentiated into strands of tracheids when they meet the xylem vessels of the host. Those which enter the host phloem are not modified; moreover, the shaft of the haustorium contains no sieve-tubes. The irritation set up by the entry of the haustorium stimulates all the living cells in the neighbourhood of the haustorium to active cell-division. In woody host stems the general result is to increase the radius of the stem of the host on the side invaded by the parasite. Connexion with the host xylem is maintained by the differentiation into tracheids of young parenchyma cells at the tip of the haustorium. Experiments in growing the parasite on peeled stems demonstrate that the plant can live on the materials derived from its host's wood, even when its chlorophyll is prevented from functioning by enclosure in a light-tight box. The haustoria formed in such circumstances are perfectly normal except that their size is less. These facts suggest that a plant's xylem is capable of transporting plastic materials as well as water with mineral salts in solution.—C. W. **Wardlaw**: Size in relation to internal morphology: No. 2, The vascular system of Selaginella. The xylem is in the form of a thin ribbon, an arrangement which makes for a large surface of interchange with living tissue. With increase in size the xylem band widens out. Where the vascular system is of large size, the broad stelar ribbon must be broken up in order to be adequately disposed in the stem. Such species are polystelic, with three to five stelar ribbons, and measurements show that a constant ratio exists between the width of the median stele and the diameter of the stem. The polystelic species have been regarded as derivative and specialised types. From the foregoing argument, however, it follows that polystely is not necessarily a derivative condition in the phyletic sense, but is a modification in form consequent on increase in size. Hence the isolated position of those species which show polystely in Baker's systematic arrangement need not be held as destructive of the validity of that classification.—S. **Williams**: Some points in the anatomy of Dicksonia. *D. antartica* and *squarrosa*.

possess dictyosteles not far removed from solenostely. In both the stele appears in transverse section as a curiously corrugated cylinder due to the oblique passage of the leaf traces through the cortex. Inwardly projecting flanges are present in both species at the margins of the leaf gaps. From a study of the anatomy of the above large stems and of a number of other examples, it is concluded that increase in size of the stele in the vast majority of ferns has been accompanied by (*a*) adaptations to increase the surface of interchange between the stele and the surrounding tissues, and (*b*) modifications of the xylem mass to ensure constant contact between the tracheids and living parenchymatous elements.—A. E. **Trueman** and Miss Daisy **Williams**: Studies in ammonites of the family Echioceratidæ. The paper deals with those ammonites from the Lower Lias which were formerly referred to *Echioceras raricostatum*. In creating several genera and in describing the species, considerable attention has been paid to the evidence obtained from the study of the ammonite sutures and from the shell development. Discussing relationships and descent, it is shown that the development of an ammonite shell frequently tends to follow the most direct line from the embryo to the adult form, and that this ideal ontogeny may be achieved by the skipping of ancestral stages which do not fall on the direct line or which do not fit the embryo for its particular environment.

PARIS

Academy of Sciences, June 8.—L. **Lecornu**: The phenomenon of refraction. A discussion of the condition which must be fulfilled by a force acting on a material point so that its velocity on change of medium may vary as predicted by the wave theory. Jules **Andrade**: Concerning a theorem of metrology: elastic clocks and spiral balances.—**Tzitzéica**: Certain skew curves.—M. **Soubbotine**: The law of errors of observation.—Lawrence M. **Graves**: Taylor's theorem in general analysis. D. **Pompeiu**: The monogeneity of functions of one complex variable.—P. **Noguès**: The invention of the kinematograph. During the period from 1882 to 1890, Marey realised the fundamental arrangement which constitutes what is now called the kinematograph.—L. **Ollat**: The resonance of coupled circuits.—J. **Cayrel**: Detection with galena. With a single isolated sensitive crystal, only the (111) faces have given rise to normal intense detection. The (100) faces, on the contrary, show a very feeble detection, nearly always inverted and often unstable. With insensitive crystals the (111) and (100) faces behave similarly: both show inversion.—E. **Bodin**: The peculiarities presented by radiation cells of great electrical resistance.—G. **Ribaud**: High frequency induction electric furnaces for the production of very high temperatures. A description of the construction of an induction furnace open at two ends and permitting the attainment of a temperature of 2500° C.—G. **Reboul**: A new mode of production of slow cathode rays.—La **Rosa**: The velocity of light and its dependence on the movement of the source of light. Reply to a communication by M. Salet.—Léon and Eugène **Bloch**: The spark spectra of chlorine. An extension of the method of analysis of spark spectra given by the authors in an earlier communication and its application to the analysis of the spark spectra of chlorine.—Pierre **Auger** and Francis **Perrin**: Theoretical considerations on the directions of emission of the photo-electrons.—Pierre **Brun**: The miscibility of mixtures of water, ethyl alcohol, and isobutyl alcohol. The results of the experiments are given in the form of graphs.—Georges **Denigès**: A new method of diagnosis and of immediate determination of cobalt by spectroscopy and chromoscopy. The blue colour given by cobalt compounds with hydrochloric acid has a specific absorption spectrum: the reaction detects 0·02 milligram per cubic centimetre of solution. The method is of service in the detection and estimation of traces of cobalt in commercial nickel and its salts.—Maurice **Nicloux**: The determination of carbon monoxide by the blood method and some remarks on the absorption of this gas by hæmoglobin in the absence of oxygen. Details of the technique of the method, which is shown to be capable of detecting carbon monoxide in the proportion of 3 parts per million.—M. **Bourguel**: The hydrogenation of the triple link. The formation of *cis*-ethylenic compounds. Using colloidal palladium as the catalytic agent, the reduction with hydrogen at the ordinary temperature of various acetylene derivatives has always given the *cis*-ethylene compound. This is in accord with the geometrical representation ordinarily adopted for the double and triple linkages in acetylene and ethylene derivatives.—Max and Michel **Polonovski**: The aminoxides of the alkaloids of the tropane group.—R. **Locquin** and R. **Heilmann**: New trinitrogen bases: the ureas of the pyrazolines.—E. E. **Blaise** and Mlle M. **Montagne**: The acyclic δ-diketones. Transformation into pyridine derivatives. The action of hydroxylamine upon the δ-diketones constitutes a general method for the preparation of pyridine bases.—R. **Bourret**: The geology of the region of Pak Lay (Middle Laos).—L. **Duparc**: Some curious lode-bearing rocks in the neighbourhood of Mestigmer (Morocco).—E. Vander **Linden**: A case of striking by lightning.—Marcel **Mirande**: The phytosterol of the scales of bulbs in the species of the genus Lilium.—C. **Charaux** and P. **Delauney**: The presence of loroglossine in *Listera ovata* and *Epipactis palustris* and on some new reactions of this glucoside.—R. de **Litardière**: The phenomenon of cytomixis in the microsporocytes of *Podophyllum peltatum*.—Ladislas **Smolik**: The exchange of the aluminium ion of soils of different types against the potassium ion of a neutral salt.—Antonin **Nemec**: The hydrogen-ion concentration in the tissue of seeds. The experiments recorded show that the hydrogen ion concentration in the seed tissues indicates, at least approximately, the value for the reaction of the medium favourable to the development of the plants arising from the seeds.—Auguste **Lumière** and Rémi **Courjon**: The influence of the time of coagulation of the blood on the toxicity of sera.—L. M. **Betances**: The genesis of the blood platelets.—H. **Chatellier** and H. P. **Chatellier**: The embryological evolution of the endolymphatic outlet in man.—E. **Aubel** and J. **Salabartan**: The significance of the decomposition products formed by the coli bacillus at the expense of glucose.—P. **Lasareff**: The statistical theory of the adaptation of the eye in the course of peripheral vision.—Ch. **Porcher**: The action of carbonic acid on the calcium caseinates. Introduction to the study of colloidal calcium carbonate.—P. Cappe de **Baillon**: The general characters of double monsters in phasmids.—J. **Beauverie**: Does the bacterial symplasm exist? The case of Azobacter. After an extended period of cultivation of *Azobacter chroococcum*, it has not been found possible to prove the existence of a regenerative symplasm which was not the result of a degenerescence, of a contamination, or of an erroneous interpretation. The author regards the formation of a bacterial symplasm as unproven.—Charles **Kayser** and Mlle Eliane Le **Breton**: The regulating mechanism of purin metabolism; diabetes.—**Paillot**: The cytological

alterations in the course of the evolution of the disease of the nucleus of the larvæ of *Pieris Brassicæ*.

CAPE TOWN.

Royal Society of South Africa, April 15.—H Spencer Jones: Notes on solar parallax. A good determination of this constant is important for establishing a base line on which our knowledge of the dimensions of the visible universe is founded. The methods of its determination may be divided into three classes: (1) the observation of the apparent displacements of a planet like Mars or Eros against one or more stars viewed from two points differently situated in relation to the centre of the earth; (2) determinations of the orbital velocity of the earth compared with the velocity of light; (3) observations of occultations of stars by the moon, from which the perturbing influence of the sun on the moon's orbit can be ascertained. The best determinations of the solar parallax from these three independent methods lead to almost identical results, namely, 8″·805 with a probable error ±0·002.—Louis P **Bosman**: Some observations on aconitine. Aconitine ($C_{34}H_{47}NO_{11}$) on oxidation yields oxonitine $C_{24}H_{31}NO_9$. It is known to contain three (CH_3O) groups, one (CH_3CO) group one (C_6H_5CO) group, and one N CH_3 group. There seems to be an inner anhydride of a dicarboxylic acid.

WASHINGTON, D.C.

National Academy of Sciences (Proc. Vol. 11, No. 4, April).—T Y **Thomas**: On the projective and equi-projective geometries of paths. O **Veblen** and J M **Thomas**: Projective normal co-ordinates for the geometry of paths. They are independent of the components of affine connexion appearing in the differential equations of the paths. Equations of paths through the origin are linear.—J M **Thomas**: Note on the projective geometry of paths. Projective tensors other than the Weyl curvature tensor can be derived. W **Hovgaard**: Determination of the stresses in a beam by means of the principle of least work. No *a priori* assumptions are made as in Saint-Venant's method.—M J **Bogert** and C N **Andersen**: Researches on selenium organic compounds. V. A simple method for the synthesis of 2-substituted benzoselenazoles.—Alice H **Armstrong**, W **Duane**, and R J **Havighurst**: The reflection of X-rays by alkali halide crystals. Using a potassium iodide crystal and reflecting X-rays from the 100 planes gave a double image and a series of fine lines, due apparently to minute crystals with their axes parallel to that of the main crystal. This habit of crystal growth is suggested as the cause of the abnormal reflections obtained with the alkali halides.—I. I. **Rabinov**: Note on the diffraction of X-rays by a wedge-shaped slit. A fringe was obtained using the K_α line of molybdenum. Calculated width of slit, 0·0013-0·0018 mm.—D L **Webster** and P A **Ross**: The Compton effect with hard X-rays.—E O **Salant**: The heat capacity of solid aliphatic crystals. Many assumptions are made, but equations are derived from which results fairly in accord with experiment can be computed.—G P **Baxter** and H. W. **Starkweather**: The density and atomic weight of helium. Three 1-litre globes were used, as in the determination of the density of oxygen (NATURE, March 28, p. 483). Average density of helium, 0·17845. Using the density found above for oxygen, namely, 1·42901, and assuming that helium obeys Boyle's Law for the range 0-1 atmosphere, the atomic weight of helium, for various values of $(PV)_0/(PV)_1$ of oxygen, varies from 3·9995 to 4·0000.

Diary of Societies.

TUESDAY, JULY 14.

SOCIETY OF CHEMICAL INDUSTRY (Annual Meeting) (at Leeds), at 11 A.M.—Presentation of the society's medal to W. F. Reid.—Presidential Address: Dyestuffs.—In evening.—Prince G. Conti: How the Tuscany Boric Acid is made (Lecture).

CONVENTION OF ENGLISH SPEAKING OPHTHALMOLOGICAL SOCIETIES (at University College) (also on July 15, 16, 17).

WEDNESDAY, JULY 15.

SOCIETY OF CHEMICAL INDUSTRY (Annual Meeting) (at Leeds), at 9.30 A.M.—Symposium on Coking Practice, Chairman: Prof. J. W. Cobb.—Dr. R. Lessing: The Influence of Ash Constituents on the Coking Process.—R. A. Mott and R. Wigginton: The Heating of Coke Ovens.—C. P. Linn: The Disposal of Coke Oven Gas for Public Supply.—W. H. Hoffert: A Comparison of Different Solid Adsorbents proposed for Benzole Recovery.

INTERNATIONAL CONFERENCE OF WOMEN IN SCIENCE, INDUSTRY, AND COMMERCE (at British Empire Exhibition, Wembley), at 11 A.M.—Opening of the Conference by the President, H.R.H. the Duchess of York.—Speakers: Viscountess Rhondda: Commerce.—Miss Ellen Wilkinson: Industrial Organisation.—Prof. Winifred Cullis: Science.

EUGENICS EDUCATION SOCIETY (at Royal Society), at 8.30.—Dr. J. A. Mjoen: The Analysis of the Component Faculties of Musical Ability and their Inheritance (Lecture).

THURSDAY, JULY 16.

SOCIETY OF CHEMICAL INDUSTRY (Annual Meeting) (at Leeds), at 9.30 A.M.—Symposium on Smokeless Fuel.—Dr. C. H. Lander and Dr. Margaret Fishenden: Smokeless Fuel: the Present Position and Future Possibilities.—L. C. Evans: Solid Smokeless Fuels: their Production Properties and Uses.—F. S. Sinnatt and J. G. King: A Study of the Tars and Oils obtained from Coal.

INTERNATIONAL CONFERENCE OF WOMEN IN SCIENCE, INDUSTRY AND COMMERCE (at British Empire Exhibition, Wembley), at 10.30 A.M.—Engineering, Chemistry and Research: Miss H. M. Davis: Electricity applied to Mining.—Miss Isabel H. Hatfield: Some Chemical Problems in the Cotton Industry.—Miss Ethel Bailey: Automotive Research.—At 3.0: Industrial Welfare and Factory Inspection: Miss Constance Smith: The Woman Factory Inspector in Industrial History.—Miss C. U. Kerr: The Effect of Welfare Work on Health and Efficiency.—Miss J. F. Wilson: The Possibilities of Advancement for Women in Industry.

FRIDAY, JULY 17.

INSTITUTION OF CHEMICAL ENGINEERS (Annual Meeting) (in Philosophical Hall, Leeds), at 9 A.M.—At 9.30 A.M. (Joint Meeting with the American Institute of Chemical Engineers): Presidential Address by the President of the American Institute: Dr. C. L. Reese; and the President of the British Institution: Sir Arthur Duckham.—At 10.30 A.M.—Symposium on Industrial Water Supply and Stream Pollution: J. P. Veitch and F. C. Benefiel: Wool Scouring Wastes.—Liquors Composition and Disposal.—Dr. I. I. Bailey: Effluents from Ammonia Plants and their Disposal.—R. D. Littlefield: Distillery Waste Liquids and their Purification.—J. B. Besschetye: Statutory Regulation of Stream Pollution and the Common Law.—Dr. J. B. Higgins and J. P. O'Callaghan: The Preparation and Comparative Performance of Base Exchange Materials in Water Softening.—Dr. F. P. Hilditch: Recent Experience of Doucil in Water Softening.—H. C. Parker: Electrolytic Conductivity and Hydrogen Ion Control.—S. L. Tyler: The Absorption of Hydrochloric Acid and Some Data regarding the Tyler Vitreosil System.—W. L. Stevenson: The State versus Industry or The State with Industry.—J. W. Sale: Pioneer Studies by the Bureau of Chemistry on Pollution of Shellfish Areas.

INTERNATIONAL CONFERENCE OF WOMEN IN SCIENCE, INDUSTRY, AND COMMERCE (at British Empire Exhibition, Wembley), at 10.30 A.M.—Commerce and Salesmanship: Miss G. Burlton: Salesmanship.—Miss L. F. Nettlefold: The Place of the Wholesaler in the Scheme of Distribution.—At 2.30.—Electricity.—Domestic Science.—Miss M. Partridge: Producing and Distributing Electricity.—Miss T. J. Dillon: At Home with Electricity.

SATURDAY, JULY 18.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (at Town Hall, Folkestone), at 11 A.M.—A. E. Nichols: Municipal Works at Folkestone.—E. C. Fawcett: Folkestone's New Sea Outfall Works.

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No. 2906 JULY 11, 1925

Evolution and Intellectual Freedom.

THE agitation in the United States over the teaching of evolution is attracting such widespread interest that it has been proposed to build a stadium to accommodate twenty thousand people for the trial of J. T. Scopes, a Tennessee High School science teacher, for having taught the truth of evolution defiance of the State law. The trial is to open on July 10. The charge of the judge to the grand jury began by reading the first chapter of Genesis as the account of creation which Tennessee teachers must adopt. He pointed out that part of the value of education is mental discipline, and that flagrant defiance of the law by the school authorities would not be a wholesome influence in the State. He insisted that the integrity of the law must be upheld. The main issue, however, will be decided by the Federal Court in its decision as to the right of a State to prohibit the teaching of fundamental philosophical principles.

The defence of evolution has been undertaken by the American Association for the Advancement of Science, which has appointed a committee of three distinguished biologists, Prof. E. G. Conklin, professor of biology at Princeton, Dr. C. B. Davenport, director of the Station for Experimental Evolution, Carnegie Institution of Washington, and Dr. H. F. Osborn, president of the trustees of the American Museum of Natural History, New York, to prepare a resolution upon the subject. The resolution, which has been adopted by the Council of the Association, is as follows:

"(1) The council of the association affirms that, so far as the scientific evidences of the evolution of plants and animals and man are concerned, there is no ground whatever for the assertion that these evidences constitute a 'mere guess.' No scientific generalization is more strongly supported by thoroughly tested evidence than is that of organic evolution.

(2) The council of the association affirms that the evidences in favor of the evolution of man are sufficient to convince every scientist of note in the world, and that these evidences are increasing in number and importance every year.

(3) The council of the association also affirms that the theory of evolution is one of the most potent of the great influences for good that have thus far entered into human experience; it has promoted the progress of knowledge, it has fostered unprejudiced inquiry, and it has served as an invaluable aid in humanity's search for truth in many fields.

(4) The council of the association is convinced that any legislation attempting to limit the teaching of any scientific doctrine so well established and so widely accepted by specialists as is the doctrine of evolution would be a profound mistake, which could not fail to injure and retard the advancement of knowledge and of human welfare by denying the freedom of teaching and inquiry which is essential to all progress."

The American Medical Association has expressed itself similarly in a resolution, passed by its House of Delegates, on the question of the teaching of evolution, "that any restrictions of the proper study of scientific fact in regularly established scientific institutions be considered inimical to the progress of science and to the public welfare."

The American Association is being helped in preparing a defence by the Science League, which was founded last year in San Francisco in order to secure liberty of teaching in American education.

These organisations have to meet a widespread and well-organised attack. The teaching of evolution has already been prohibited by law in Oklahoma and Tennessee. Bills for the same purpose were submitted to the State legislatures in Kentucky and in Texas and were rejected by the Upper House, in Kentucky by a majority of one vote. In Florida the legislature passed a resolution advising the educational authorities not to employ those who teach Darwinism, and the agitation for direct prohibition is still maintained. In North and South Carolina legislative action against the teaching of evolution was defeated, but text-books and teachers who favour evolution are debarred from the State schools. Georgia has as yet no absolute legislation on the subject, but the State Education Committee last July advised the legislature to refuse grants to any school, college, or university that favoured the doctrine of evolution, and it has recently withheld a grant from a State library because it contains books on evolution. Bills against the teaching of evolution are being introduced or have been introduced into the legislatures of the States of Arizona, Arkansas, Georgia, Illinois, Indiana, Iowa, Minnesota, Mississippi, North Dakota, Oregon, and West Virginia.

In California the effort was made, as mentioned in NATURE of May 9, p. 683, to avert a struggle by reference of the question to a committee of the nine

presidents of the State universities and leading colleges. Six of these colleges are under denominational control, and the unsatisfactory compromise previously referred to in NATURE has not satisfied either side. A requisition is being signed for a reference of the question to a ballot at the next election; and the Fundamentalists are said to be confident that they will carry the State, unless books which give even a moderate approval of evolution are excluded from the schools.

The anti-evolution party is being supported to some extent by the publishers. Thus, one distinguished New York biologist has been requested by his publisher to omit any reference to evolution in any new editions of his text-book, owing to the objections of the Southern and Western States. The intellectual terrorism in some of the States may be judged by the fact that according to the *Boston Evening Transcript* of May 23, although, while the anti-evolution Bill was before the legislature in Tennessee, many clergy protested against the proposed infringement of freedom of opinion, "there was never a word of protest from the State University." The North-eastern States show by the comments of the Press their deep regret at this outbreak of intellectual obscurantism, and it is to be hoped that an authoritative expression of opinion there may help the Southern and Western States to realise the heavy handicap they would be laying upon themselves, as well as upon their universities and schools, by the legal prohibition of well-established scientific principles.

In Great Britain, State interference with university teaching would not be tolerated. The proper body to decide what may or may not be taught in a university is the Senate or Council, and not a popularly elected civic chamber of any kind. It must not be forgotten, however, that education authorities in England exercise the right of control over the teaching of religious doctrine in schools, and that they could apply the same powers to the teaching of evolution if they wished. It is not for us, therefore, to attempt to justify what seems to have been a breach of law in the State of Tennessee, however much we may deplore that a State should pass a measure which is contrary to all modern ideas of progressive thought and intellectual freedom. What we are concerned with is the principle by which a political party or organisation should be able to put obstacles in the way of human enlightenment and independent thought, and should have the power of approving, or preventing, the teaching of scientific facts or conclusions of any kind. We have long passed the stage at which this was possible in England, and cannot help being astonished, therefore, that there should be States in the United States of America which deliberately adopt a policy of scientific stagnation.

In order to ascertain the views of leading authorities in the fields of university work, science and religious teaching, upon this attitude, advance proofs of this article have been sent to a number of representative men, whose comments, here subjoined, will, we believe, be read with interest on both sides of the Atlantic.

Prof. WM. ADAMS BROWN, Ph.D., D.D.,
Roosevelt Professor of Systematic Theology, Union Theological Seminary, New York.

MY friend, Prof. Wildon Carr, has suggested to me that it might interest readers of NATURE to learn the views of an American observer as to some of the antecedents of the singular case presently to be tried in Tennessee. The incident, dramatic as it is, is not an isolated event, but part of a movement the beginnings of which go back many years, and has already caused a serious rift in several of the more important denominations; it cannot be understood without reference to its larger setting.

The first factor to be borne in mind is geographical. The United States, in spite of its hundred and ten millions of people, is still, judged by European standards, sparsely settled, and within its ample borders includes populations separated from one another by differences of antecedents, habits, and tastes, scarcely less marked than those which separate the different countries of Europe. There are wide areas of the United States in which the inhabitants know as little of what goes on along the Atlantic seaboard as the inhabitants of China or India. To understand the psychology of Fundamentalism, one must see such a play as "Sun-up," and remember that it truthfully describes the mental attitude of hundreds of thousands of American citizens of the purest English stock.

A second factor to be reckoned with is the tendency of Americans to standardise their thinking. This characteristic, which constantly surprises the English visitor, accustomed to the free expression of individual opinion on every topic under the sun, has its explanation, if not its justification, in the exceptional conditions under which the American democracy has developed its national life. With a people recruited from every quarter of the globe, living under conditions which stimulate individual initiative, there was grave danger that the unity of the national life might be lost unless the variant elements could be held in check by a powerful public opinion. In Great Britain, centuries of tradition have fixed habits of action in certain definite grooves, and one can safely allow himself the luxury of freedom in his thinking.

In the United States, where tradition is at a discount, and each man does what the need of the moment seems to require, there must be some steadying and conservative influence, and this, apart from the written constitution, is supplied by a powerful and often tyrannous public opinion. What is going on in religion in the so-called Fundamentalist movement has its parallels in economics and in politics. Feeling is often substituted for reason, and the nonconformist is punished by social disapproval, if not ostracism.

To understand the theological antecedents of Fundamentalism one must go back a generation to the Briggs case, the celebrated heresy trial of the last decade of the last century, which in so many ways paralleled the Robertson Smith case in Scotland. There, as here, the issue was the inerrancy of the Scripture; there, as here, the first result was the condemnation of the accused; but, at this point, the parallel ceases. In Scotland, the result was a revival of Biblical study carried into the homes of the people by a generation of ministers who were teachers as well as preachers—a revival which familiarised the rank and file of the people with the issues involved, robbed criticism of its terrors, and prepared the way for the saner and more scientific theology of to-day. In the United States, this result followed with certain individuals and in certain sections of the country, but for the most part the effect was different. The Briggs case shook the faith of many a minister in the old theology without giving him a firm grasp on the new. He therefore ceased preaching theology altogether and turned to social service or some other practical interest as a substitute. The result is that the present issue comes upon a people unprepared to meet it, and easily swept away by the plausible rhetoric of an orator like Mr. Bryan, who has learned by long practice to make words do duty for ideas.

It must be further recognised that when their real interest is separated from the fantastic opinions with which they have associated it, the Fundamentalists are contending for something with which men of a very different mental outlook may feel sympathy, namely, a positive and constructive Gospel. In the general loosening of old ties which has been the aftermath of the War not a few self-styled liberals have been ready to break completely with the past, and lightly to surrender values painfully won by the labour and sacrifices of many generations. The spectacle of this light-hearted radicalism has seriously alarmed many who would have been ready to respond to a saner presentation of the newer views, and, yielding all too readily to the psychology of the crowd, they have allowed themselves to lend their support to positions which, under less trying conditions, they would be the first to repudiate. It is not the first time in the history of religion that a good cause has been discredited by the agents of which it has made use.

One further point requires brief notice. In spite of the factors I have mentioned, the controversy would not have reached its present acute stage if there had not been on the Fundamentalist side a systematic popular campaign, amply financed, which has carried the cry of the Gospel in danger into every section of the country. Only recently have the advocates of a reasonable Christianity realised the danger which confronted them, and organised for a similar campaign of education on the other side. That realisation has, however, come at last and that organisation been effected, and unless the American people have been permanently bereft of the good sense which has hitherto characterised them in critical hours, we may confidently expect that the forces of reaction will be checked, and a reasonable liberty of thought be safeguarded.

Sir Ray Lankester, K.C.B., F.R.S.
Formerly Director of the Natural History Departments of the British Museum.

In the article about to be published in Nature which you have sent to me for comment, I do not find any definite information as to the law or laws said to be operative in certain States of the American Union by which the teaching of the doctrine of evolution is forbidden, nor do I find any precise statement of the power said to be exercised by certain States of withholding pecuniary support or, on the other hand, of giving it to colleges or schools which teach or do not teach subjects approved or disapproved by the State legislature. One must suppose that such *direct* control of the educational programme of colleges and schools supported by grants from the public purse is approved by the citizens who elect the legislative body. If the wishes of the constituency are carried out, lookers on may regret or disagree with the programme enacted, but must admit that the action is in accordance with the fundamental principles of self-government. If the action is not in accordance with the wishes of a majority of the constituency, that majority can elect new representatives pledged to the policy it prefers.

Another very important question is raised in your article about which I have no information. You say that the Federal Court has the power "to decide as to the right of a State to prohibit the teaching of fundamental philosophical principles." One would wish to hear more about this power of the Federal Court, and also as to the interpretation of the term "fundamental philosophical principles." In the absence of information on these matters it would be rash to pursue the

subject further. Clearly enough (in my opinion) the integrity of the law must be upheld. The "law" can be altered by a regular constitutional method, but there seems to be no justification for disobeying it instead of repealing it.

The normal and healthy result of the exclusion from State colleges of "studies" which many citizens desire to be made accessible for themselves and their young people, must be to bring about a "boycot" of the State institutions in question, and the endowment of free "nonconformist" colleges to take their place. In many respects educational enterprise flourishes best when free from State interference, State prejudice, State ignorance, and State jobbery. The great universities of the United States are independent corporations, and so are Oxford and Cambridge and their colleges, and so too are the other great universities of Britain. The State government does not at the present day presume to control their programme of studies, but rather protects them from fanatical influences and secures them in the possession of property which enables them to pursue the making and the diffusion of knowledge with independence and self-respect. The present freedom of student and professor and the self-governing status of "Universities" in Great Britain is the outcome of long and historical struggle. That status is not theoretically complete even now, but is in a reasonable state of adjustment to the demands of healthy progress. The university is expected in Great Britain to be (and *is*) tolerant of divergent opinions. It unites learned men of various philosophical outlook in a common effort to increase knowledge and to promote its diffusion through all classes of the community.

It must be incredible to British teachers that a judge charges a grand jury by reading out the first chapter of Genesis and declaring that that is the account of creation which Tennessee teachers must adopt. As a matter of *fact* that is *not* what the judge said. What he said was that, according to the law of the State of Tennessee, a teacher could not legally be paid his salary unless he taught the first chapter of Genesis as true. A Tennessee high school science teacher refused to give that teaching, and so has gained an enormous journalistic advertisement.

The whole affair is being worked by journalistic enterprise in the States on a misleading basis. There is no "trial" of the advertised teacher. He is no martyr. He is simply a case of the very ordinary failure of an employee who will not carry out the terms of his engagement and is dismissed accordingly. He is under no compulsion. He can teach according to contract or he can go elsewhere. He prefers to go. The interesting questions which remain for solution are: (1) Do the free and independent citizens of the State of Tennessee approve of the action of their legislature in regard to the first chapter of Genesis? (2) Will the Federal Court over-ride the interference of the State legislature in this special instance? It will take time to educate the citizens of Tennessee so as to enable them to judge whether their legislature is wise or foolish in endeavouring to exclude the teaching of the doctrine of evolution from State-supported colleges. We must wait and see. But in the meanwhile the great colleges of Harvard, Yale, and Princeton and the scientific academies and museums of the United States are not affected by this storm in a tea-cup.

P.S.—I should like to place on record the fact that at Oxford in 1873 I gave, as deputy of the Linacre professor of anatomy and physiology, a course of public lectures on "The Genealogy of the Animal Kingdom," in which I fully accepted and taught Darwin's doctrine of descent. Neither at Oxford nor afterwards when I gave a similar course of lectures at the Royal Institution in London was there the smallest protest or objection raised to the straightforward teaching of the doctrine of evolution and Darwinian zoology. On the contrary, I received warm encouragement alike from professors and undergraduate students.

Prof. E. W. MacBride, D.Sc., F.R.S.,
Professor of Zoology, Imperial College of Science and Technology, South Kensington.

The remarkable movement in America aiming at the suppression of the teaching of evolution in schools and universities is too widespread and has far too much momentum behind it to be accounted for as a mere outbreak of intellectual obscurantism. The general public there, as elsewhere, is profoundly uninterested in scientific speculation, unless this is discovered to have a practical bearing on life. It is because, in the opinion of the average American, the doctrine of evolution as taught in American schools and colleges is liable to defeat the purpose for which those institutions were established that he has risen in revolt against it.

The Fundamentalist argument is as follows: These schools and colleges from which we desire to exclude evolutionary teaching were established by men brought up in the Puritan tradition, which has largely moulded and developed the American national character, of which we are all proud. The object for which these homes of learning were founded was not the imparting of abstract truth but the training of men to be good citizens. Evolutionary teaching in America has led to a purely materialistic and mechanistic view of life: it teaches that individual men are mere ephemeral bubbles on the surface of things: that their moral ideas are only tribal taboos of no particular validity: that "conscience and

free-will," to quote a leading exponent of "behaviourism," "are mistakes of the older psychology," that "God" and "Heaven," according to another evolutionary philosopher, "are defence-mechanisms different in degree but not in kind from the illusions of the paranoiac," and the widespread acceptance of such ideas would undermine the American character.

The most practical objection to the Fundamentalist position is its entire futility. Nothing could do more to stimulate widespread interest in evolutionary views than the attempt to prohibit them. The American youth in particular resents being forbidden any of the fruits of the tree of knowledge, and the attempt to do so will only whet his appetite for them. Just as hundreds of boys and maidens now indulge in whisky drinking who in pre-prohibition days never dreamt of such a thing, so it is to be anticipated that hundreds of youth who previously were entirely satisfied with cinemas and baseball will become evolutionists.

The only way effectively to combat the mechanistic view is to build up a thorough and convincing idealistic criticism of it. This is the path which has been followed in England; indeed few if any of the great Victorian scientists were blind to the enormous intellectual difficulties involved in a thoroughgoing materialism: for this reason Huxley, amongst others, wisely adopted the position which he termed "agnosticism"—freely acknowledging that problems of the relation of mind to body were entirely beyond the competence of science to solve. Since Huxley's day, idealistic criticism has grown in strength, and so it has come about in Great Britain that all sorts and conditions of men, including reverend bishops of the Church and nonconformist divines, accept evolution, whilst still refusing to accept a mechanistic view of life and the universe. We commend the consideration of these facts to Fundamentalists in America.

Sir Arthur Shipley, G.B.E., F.R.S.,
Master of Christ's College, Cambridge.

The average American of the Middle and Southern States is a very naive mammal. As a "prominent citizen" tells us in the current number of *The National Review*, the United States is a nation of adult children, and certainly some of the things they do seem to older and more mature countries decidedly childish. The farmers and the Methodist and Baptist pastors of States like Tennessee, Kentucky, Oklahoma, are really convinced that they can make a people moral and religious by enacting laws. But the laws in America are so seldom enforced. Before the War some eight or nine States passed a law by which all lunatics and criminals were to be sterilised, but I believe the law has only been observed in one or two cases. Seven years ago I was sitting next to a very vinegary lady at Desmoines in Iowa. She was jubilant over the Volstead Amendment, and said they would now tackle tobacco, and as soon as they had got that noxious weed out of the way, they would have a world campaign against the drinking of tea or coffee, both of which she understood contained poisons. She closely cross-examined me as to whether the students at Cambridge were allowed to smoke, and when I told her that they were, and that I hoped they did, because we believed in the freedom of the individual, she became almost abusive. But finally I silenced her by saying that she seemed so devoted to liberty that she wanted to take it away from everybody else in order to add to her own store.

Now, in several States there is an attempt to control free thought. In the Churches, America has scarcely passed beyond the region of the Presbyterian prosecution of Robertson Smith nearly fifty years ago. They have heresy-hunts, again an attack on free thought. The Ku Klux Klan movement is largely directed against certain forms of religious faith. They are

> "Fightin' like divils for conciliation,
> An' hatin' each other for the love of God."

But all the laws they pass can be and are evaded, and one has no doubt that in those States that have forbidden the teaching of evolution, evolution will still be taught. Unfortunately, as a whole the people of these "sections" are not a reading people, and seldom soar above a light illustrated magazine, or they would read what they may not be taught. The new text-book with which the Tennessee text-book commission has replaced the one used by Mr. J. T. Scopes states, "In reference to all animals resembling man, none of them are to be thought of as a source of origin of the human species." But, after all, thought is free, in spite of Mr. William Jennings Bryan, if one likes to think that man descended from animals resembling man, it will be very difficult to stop it.

Of course, there is a great deal of money in these proceedings. It will be the making of Dayton, where nothing has ever happened before and there is doubtless an expensive publicity agent with an itching palm. The average European who has not seen it has no idea of the "lobbying" carried on by the more pushing publishers in the United States to get their books adopted. Text-books are remunerative, and whoever has got the contract for these new biology books will probably make a very good thing out of it. In the days of Henry Newell Martin, if he wrote a "Physiology" which was to be adopted as a school book by any State, he had to append a chapter on the

dangers of alcohol, otherwise it had no chance of being accepted. As Kipling says of the American:

Enslaved, illogical, elate,
He greets th' embarrassed Gods, nor fears
To shake the iron hand of fate
Or match with Destiny for Beers.

Of course, now it does not pay to make beer in America, you must substitute synthetic gin for the last word of the couplet, but unfortunately synthetic gin does not scan.

The Right Rev. E. W. Barnes, D.D., Sc.D., F.R.S., Lord Bishop of Birmingham.

The ignorant fanaticism which has led to the proscription of evolution in certain Western States of America is deplorable. As one who values intellectual freedom I am shocked that Anglo-Saxon communities should seek by legislation and prosecution to prevent the spread of knowledge. As a Christian I am dismayed by a movement which opposes a reasonable formulation of the Christian Faith. Cumulative and well-tested evidence has convinced every reputable biological expert throughout the civilised world that man has evolved from an ape-like stock. The normal educated Christian in Great Britain regards the process of evolution as the machinery by which God has created man. Every divine of any eminence among us accepts this point of view. Such acceptance strengthens the Christian position, for it makes the spiritual interpretation of the universe which we derive from Christ more convincingly reasonable.

No part of the teaching of Jesus, as set out in the New Testament, can by the most ingenious sophistry be held to imply belief in the literal truth of the Genesis account of creation. The "Fundamentalists" forget that the Bible is a spiritual treasure-house, not a scientific manual. They ignore the Christian doctrine that the Holy Spirit is still at work among men, leading them to an ever fuller understanding of truth; with a fear that is really anti-Christian, they assume that a fuller knowledge of truth will weaken rather than establish the Christian revelation. The inevitable result of their attempt to repudiate sound science in the name of religion will be that tens of thousands of college boys and girls in America will repudiate Christianity in the mistaken belief that it is bound up with pitiable ignorance.

In England the battle was fought out more than a generation ago. From the blind religious prejudice of men like Pusey, Samuel Wilberforce, and Gladstone (why do political leaders damage their fame by theological obscurantism?) we were mainly saved by the enlightened boldness of the Victorian liberal divines; of Archbishop Temple; of Frederick Denison Maurice, who was never tired of quoting the spirit of Darwin's investigations as a lesson and a model for churchmen; of his friend Kingsley; of Bradley, the Dean who buried Darwin in Westminster Abbey; of Farrar, who preached his funeral sermon; of Canon Wilson, who still survives in honourable old age. But without such men the truth would have prevailed. It will prevail in the long run in the United States. Of what avail was it that the Roman church placed heliocentric treatises on the Index of Prohibited Books? The earth moves: and the mind of man moves also to embrace an evergrowing understanding of the mystery of creation.

Prof. W. J. Sollas, Sc.D., F.R.S., Professor of Geology, University of Oxford.

The action of the State of Tennessee raises a number of questions which it would be interesting to discuss were it not that they are all subsidiary to the one which agitates the minds of all freedom-loving peoples, *i.e.* the right of the State to suppress the teaching of scientific truths. On the subject of evolution there is, I believe, among competent thinkers but one opinion. To put it in a form that will be readily understood by our Puritan friends, all zoologists and botanists are agreed that the creation of species, including man, proceeds or has proceeded by way of evolution. This a theory which might almost be regarded as a fact; it is so widely and surely based that it might be ranked as of equal certainty as the revolution of the earth around the sun, a subject which supplies an interesting parallel with the present one if only we substitute Papists for Puritans.

But all endeavours to suppress a truth are as futile as they are false. If natural history is to be taught at all in the schools, then in the end the truth will out. The structure, functions, habits, and distribution of animals and plants are, it is true, subjects of such absorbing interest that lessons upon them, from which all theory is carefully filtered off, are sufficiently attractive in themselves to arrest the attention and engage the studies of a class, but the interrelation of the facts they disclose must inevitably suggest many searching inquiries, and curiosity once aroused will not rest satisfied until it has received an answer. Then, if we are really back in the days of the Inquisition, the next step which will devolve upon the State will be the institution of an Index Expurgatorius. Short of this the truth will no longer rest concealed.

We reach, then, a stage when the community will arrive at a knowledge of the facts of evolution. Then comes the question—What about its explanation? There we are on very different grounds. It is no secret that Darwin's explanation no longer occupies

undisputed possession of the field, and there are without doubt many distinguished investigators who freely admit that a satisfactory explanation has yet to be found. For myself, I confess that I regard the Darwinian explanation as only a half truth, and I think that the discussion of this question requires wider knowledge and greater maturity of judgment than the schools are likely to provide. It should be left to the universities, and even then the implications of all evolutionary theories should be carefully borne in mind, for the effects of some of them, if rashly introduced into ethics, personal, social, or political, might prove to be disastrous in the extreme.

Sir Arthur Keith, M.D., F.R.S.,
Hunterian Professor and Conservator of Museum,
Royal College of Surgeons of England.

It is in no spirit of levity that I, a life-long student of the human body, would quote here, for the benefit of Fundamentalists, both at home and abroad, a saying of that Master whose teaching they claim to follow: "Father, forgive them, for they know not what they do." For if their desires are fulfilled, the teaching of anatomy will become a colossal system of organised hypocrisy. In every sentence of his lecture, a professional anatomist, who is compelled to base his teaching on the first chapter of Genesis, must sin against the truth which is in him. If the teaching of evolution is proscribed, then the study of the development of the human body must be forbidden by law, for in its development the human body proclaims that evolution is true. Dissection will have to be forbidden; for every one, be he teacher or student, who dissects man's body and compares it with that of apes and of monkeys, has the same truth forced on his perception.

Only penal servitude for life will keep men from searching the records of the rocks and discovering that the earth itself has kept a detailed history of plant, beast, and man, and all of these records shout aloud that evolution is true. All the fossil remains of primitive man, of beings who are almost as much ape as man, will have to be destroyed and all written description of them obliterated if Darwinism is to be undone. The stone implements of ancient man, which have been gathered with such meticulous care from recent pages of the earth's history, will have to be gathered together and solemnly carried to the deepest sea and there sunk. For these silent witnesses carry the history of man and the history of woman tens of thousands of years beyond the days of Adam.

Archæologists must be forbidden to enter Egypt and Mesopotamia, for they are carrying history further back than the Bible allows. Astrology must replace astronomy; alchemy, chemistry; children must be taught that the sun and moon revolve round the earth, if the Bible is to be standard text-book of the modern teacher of science.

Men who propose to bring about such a change "know not what they do." They do not know the world they live in. For what they have set out to do is to turn the hand of the clock of progress back to a point it reached four thousand years ago—to a point when teachers of anatomy assured their students that woman was made out of Adam's twelfth rib. If Fundamentalists push their proposal to the point of practice, they will certainly smash the "rock of ages" but they will leave unharmed the "record of the rocks."

Prof. G. Elliot Smith, M.D., F.R.S.,
Professor of Anatomy, University College, London.

The proscription of the teaching of evolution in any university cannot fail to destroy the influence and in fact the very existence of such an institution. For the purposes of a university are to advance and diffuse knowledge and to inculcate the discipline of the search for truth. To deny it the freedom to cultivate these objects is to eliminate its right to exist.

Such action can do no harm to the theory of evolution: nor can it stifle the spirit of truth. But it does reveal the depth of ignorance and stupidity of those who assume that it is possible in the twentieth century to suppress intellectual freedom and to eliminate the spirit of honest inquiry from any community. Moreover, the ignorance is not merely of science but even more of the lessons of history. This campaign for fettering intellectual pursuits has been pursued with a variety of excuses for more than three centuries. In spite of ephemeral triumphs it has invariably ended in disastrous defeats, injuring the misguided fanatics themselves far more than the cause of truth they are trying to stifle. For it is clear the Tennessee comedy is not concerned primarily with evolution: it is essentially the three-century-old attempt to destroy intellectual freedom. The denial of evolution now occupies the place that even so recently as fifty years ago certain theologians assigned to the claim that the earth was flat and fixed in space.

But the reality of evolution is as certain as the fact that the earth revolves around the sun. The former is as essential a part of all modern biological thinking as the latter is of astronomy. Hence the change of the issue does not help those who are stupid enough to imagine that the fact of evolution can be suppressed.

In 1615 Galileo was summoned before the Inquisition, which unanimously declared his proposition that "the sun is the centre and does not revolve about the earth" to be "foolish, absurd, false in theology, and heretical, because expressly contrary to Holy

Scripture." In spite of repeated humiliations, certain theologians (and especially those in the Southern States of America) only finally abandoned these claims that did infinite harm to their own cause less than fifty years ago. The substitution of the biological for the astronomical issue can only result in adding vitality to the ridicule that is certain to overwhelm these misguided people, who know not what they do.

Prof. W. C. McIntosh, D.Sc., F.R.S.,
Emeritus Professor of Natural History,
University of St. Andrews.

Trained from early days in biology on the shores of the rich Bay of St. Andrews under William Macdonald, George E. Day, and Miss Otté, the translator of De Quatrefages' "Rambles of a Naturalist," and later under George James Allman and John Goodsir in Edinburgh, before the appearance of the "Origin of Species," it has been my fate to witness all the vicissitudes of support and opposition (often with personal knowledge of the men) to which this epoch-making work gave rise. Close occupation in zoology and a disinclination to theorise have prevented personal work in a field so fascinating and so fruitful to many, yet such could not check an impartial judgment of the facts. In Great Britain about fifty years ago, it is true that the leanings for and against evolution were each in turn keenly opposed in elections for certain university chairs. It is long, however, since such straitened views have disappeared, and men of every grade of opinion on the subject have been dispassionately chosen on their real merits, and perfect freedom of opinion afforded to university and other teachers. This experience has not resulted in the lowering of the esteem for what is good, nor has it altered the value of the Bible or of religion, nor has it undermined the moral principles and character of the nation—upon which so much depends.

The breadth of view and the great impetus the evolutionary theory has given to the study of the natural sciences cannot be denied. Its value, for example, is of the greatest importance in grasping the relationships of fossil and recent types of every class, from the simple Palæozoic forms to those of the Pleistocene period. Knowledge is a universal goal, and scientific knowledge especially cannot be hampered by restrictions, however well intended. It seeks truth only and labours long to find it. The teaching of evolution in schools and colleges of the United States was perhaps unknown to many in Great Britain, but the veto of some of the American States authorities against such teaching seems to carry us back to the Middle Ages, when free thought and conviction on certain subjects were fraught with violent opposition and danger. I do not hesitate, therefore, in joining my scientific colleagues in protesting against this infringement of freedom of thought—affecting responsible officials of high character in universities and schools of the United States.

Rev. Hilderic Friend,
Wesleyan Minister.

My biological researches commenced close on half a century ago, when the Churches were almost all strongly opposed to Darwinism. My bias, therefore, was, from the outset, against the theory of evolution. Yet every step taken in the study alike of botany and zoology, of anthropology and religion, tended to show me that the secret of life was to be found, if anywhere, along the lines of evolution; and there was no other theory in the field which could meet all the difficulties involved in the mystery of life. Genesis states a fact, evolution attempts an explanation.

As a student of divinity, long familiar alike with the idea that science and religion were in conflict, and that the doctrine of evolution intensified the supposed antagonism, I have found in that doctrine the most satisfactory solution of my problems as a teacher. I owe much also to the fact that, in my plastic years, I resided in the East, and became familiar with Oriental imagery and modes of thought.

I find the doctrine of evolution in fullest harmony with all that I have been able to discover by practical study of Nature and comparative religion, as well as by personal experience. While I have the highest respect for law and order, I cannot but wonder that the making of laws relating to the education of the race should be in the hands of men so reactionary and ill-informed; men who have failed to learn anything from the past. All history teaches us the unwisdom of opposing new modes of thought. Christ had to insist on a revision of the Mosaic law, as being out of harmony with the thought of the age, and time has in fullest measure justified his action. The Church in vain attempted to suppress the teaching of Galileo. If this thing is of men (as a wise man once remarked) it will come to nought; but if the doctrine be true it cannot be overthrown. The truth will prevail. Nothing can be gained, and much will inevitably be lost, by any attempt to enforce legislation against the teaching of evolution.

It must, however, be conceded that much present prejudice and misunderstanding is due to the want of thought and tact often displayed by propagandists. For the future, in order to obviate these things, the teaching of science as well as that of religion must be entrusted to our wisest, best, and most carefully

trained educators. Whatever of error there may then be in their teaching will eliminate itself, and the doctrine of evolution may safely be left in their hands to establish itself if it be true, to develop and unfold if it be imperfect, or to perish if it be false.

F. A. Bather, D.Sc., F.R.S.,
Keeper of the Department of Geology, British Museum (Natural History).

This medieval gesture is curiously half-hearted. Complacently to accept the material benefits of research and to reject the intellectual results, to prefer the electric light to the light of reason, the loud-speaker to the still small voice of the spirit: this is worse than a frank return to the Dark Ages. But the attackers of evolution have apparently never considered what is meant by it. Possibly some of its defenders also have not considered. The attack at any rate is confined to organic evolution (atoms and automobiles may evolve as they please), and the spear-point of it is directed against the statement that man is descended from the anthropoid apes. Few would accept so crude a statement nowadays, but any statement that zoologists could substitute for it would, no doubt, be equally objectionable.

Education, however, is the field of battle, and a teacher may perhaps grant something to the other side. Evolution is a theory of creation. There are other theories, and some of them, held by thousands of well-meaning people, may not be taught in the State schools of certain countries. Perhaps it is just as well not to teach any theories. A teacher who is not himself an investigator is liable to be too dogmatic and to bring forward a theory as a ready-made explanation of matters which he is really (like the rest of us) unable to explain. The right of free thought and free speech is one thing; the guidance of the young is another.

As a palæontologist I should be quite prepared to teach facts, leaving their philosophical interpretation for later years. The intelligent among my pupils would probably come to the same broad conclusion as all palæontologists have come to, and they would have had a better intellectual training than if the theory had been forced into them.

Are not the Americans a little too ready to substitute theory for fact in their educational courses? Perhaps this attack is the inevitable reaction, and it may prove not unwholesome. It would do us all good to drop "that blessed word Evolution" for fifty years.

The controversy will be entertaining and a boon to the newspapers; but is it seriously supposed that all the eminent biologists in the world could convert Mr. Bryan and his friends? As easily would President Osborn convert Mr. Bateson to his particular belief.

D. H. Scott, D.Sc., F.R.S.,
Lately Honorary Keeper of the Jodrell Laboratory, Royal Botanic Gardens, Kew.

The resuscitation, in certain of the United States, of the old "Science *v.* Religion" conflict is a curious and interesting phenomenon, which need not seriously disquiet the scientific world. The Fundamentalists are quite right in holding that a belief in evolution is fatal to their own stereotyped form of religion. If religion is to be wholly unprogressive, then science also must be kept stationary; otherwise a collision is inevitable, and science is bound to get the best of it in the future, as she has constantly done in the past.

The surprising point about the American conflict is that it has come so late. Sixty years ago, when Darwinism was young, we were quite accustomed to this kind of antagonism in England, though it does not appear that we ever went so far as to prohibit the teaching of the new doctrines.

It may be doubted whether, among scientific men, there are any now living who reject the theory of descent. From a biological point of view this is, in fact, the only theory in the field, for the old doctrine of special creation was no more than a confession of ignorance. To account for the origin of species by asserting that species were created by the Deity is as if we were to attribute the origin of the Himalayas to the act of God, instead of trying to find out how and by what forces their elevation was accomplished.

It is probable that those who dislike evolution may have been misled and unduly encouraged by the recent frank statements of some eminent biologists, who have acknowledged how little we know of the methods of evolution. The difficulties are no doubt more fully realised now than they were a quarter of a century ago. But Mendelism and its implications no more cast doubt on the reality of evolution than the theory of relativity invalidates the discoveries of Copernicus.

Of late years I have often had occasion to direct attention to the difficulties in tracing the course of evolution in the plant world. The problem is extremely involved, and many questions must be left open. None the less, the general conclusion that the past history of plants, like that of animals, is nothing but the record of an evolutionary process, remains firmly established.

Rev. Frank Ballard, D.D.,
Christian Evidence Lecturer for the Wesleyan Conference.

It is difficult to write with judicial calmness concerning the state of affairs exhibited by the approaching "trial" of Mr. J. T. Scopes for teaching evolution in

the Tennessee High School. The assumptions of Fundamentalism are so preposterous, alike in theory and in practice. I am not altogether surprised, when I call to mind my experiences in America a quarter of a century ago. It was pitifully manifest then, that both in science and theology, many of those who posed as authorities were half a century behind the times. But one did hope that the intervening years would have opened their eyes. The notion of a Judge's charge to a grand jury beginning with the reading of the first chapter of Genesis—"as the account of creation which Tennessee teachers *must* adopt"—of course in the Fundamentalist sense—savours of the sixteenth century rather than the twentieth.

In view of the whole case, there are two questions which loudly call for unequivocal answer. (1) The first is whether universities are to be free to teach what is true, in the light of advancing knowledge, or are to be for ever throttled by the grip of theological obscurantism. Unless this latter alternative be met with an overwhelming negative, humanity must simply drift back to the miserable darkness of the Middle Ages. (2) The other question is whether the view of creation, with all its consequences, which is dogmatically insisted on by Fundamentalists, is so true that nothing more remains to be learned.

It is not too much to say that, in these days, every child in a respectable school knows that it is not. Whatever room and need there may be for the correction of Darwinism, and the re-statement of evolution in the light of our latest knowledge, this certainty emerges, as plainly as the light of dawn after the dark, that the "creationism" which pivots itself in the opening chapters of Genesis is wrong; and its inferences are as false as they are dangerous, as mischievous as they are dogmatic. Neither God nor man is such as the Fundamentalist shibboleth declares. To say nothing of palæontology, biology, and embryology save that they cannot now be extinguished by ecclesiastical anathemas—every Fundamentalist bears about in his own body a hundredfold proof that his main contention is untrue. That ought to suffice, not only for all the twenty thousand who are to fill the stadium for the "trial" of July 10, but also for every sane and sincere man or woman on earth.

W. Bateson, D.Sc., F.R.S.,
Director of the John Innes Horticultural Institution, Merton, Surrey.

I am glad to add a few words to what I wrote in Nature of September 1, 1923, p. 313. The Tennessee trial is something more than a curiosity in the history of civilisation. Wherever science and learning are valued, sympathy with the unfortunate victims of this new persecution will be unanimous and deep. They suffer in the cause of truth, if ever men did. To them personally we trust that at least some restitution may be made.

None of us can, however, be indifferent to the issues now being raised on a great scale for the first time in the modern world. The opinions of Tennessee and similar communities respecting the evolution of animals and plants would not seem to be a matter of general concern, but the symptom is really one of grave trouble, and the tremor now perceptible is an indication of a strain in the social fabric which sooner or later may end in catastrophe. To the nineteenth century, the dissemination and inculcation of scientific truth wholesale was an object almost as desirable as actual discovery. The fundamental and permanent heterogeneity of the population was not appreciated as a fact of any consequence. With education it was expected to disappear. Nothing of the kind has happened. If the true convictions of our own people could be ascertained, I do not suppose they would be found to be very different from those of Tennessee. We are fortunate in having a somewhat larger proportion of the rarer elements as an ingredient in our population—men whose minds are as Plato might have said, "released"; but they are a mere fraction in any community, and it is a miracle that they are able to impose a precarious authority sufficient to protect themselves from molestation.

Upon the still larger considerations which lie behind, we, as scientific men, are not required to pronounce. Whether a State stands to gain or to lose by the encouragement of intellectual freedom in comparison with others which control or suppress truth is a problem on which political philosophers have exhausted the arts both of eloquence and sophistry. No universal solution, independent of time and place, can be expected. But one thing is certain: that to us our liberty is vital; and to suppose that movements of this magnitude in the United States have no significance for ourselves is to cherish a very dangerous illusion.

Sir Sidney Harmer, K.B.E., D.Sc., F.R.S.,
Director of the Natural History Departments, British Museum.

It is difficult for those of us in Great Britain who have recently taken part in the centenary celebrations held in honour of Huxley, the champion of intellectual liberty, to realise the consequences of a successful attempt to control scientific thought, or to believe that a result of that kind is possible in a great country like the United States, which has always prided itself on being the home of freedom. The danger is, however, a very real one on the other side of the Atlantic, and our scientific colleagues there who are fighting the battle can count on the unanimous support of workers on this side.

Considerable harm has been done in America by the failure to realise that a want of agreement as to the causes of organic evolution does not imply any difference of opinion with regard to evolution itself. The evidences for the origin of animals and plants as we now see them, as the result of evolutionary processes, seem to us, as to our distinguished co-workers who stand for intellectual liberty in America, too plain to be doubted. Even if, like Malvolio, we did not approve the opinion of Pythagoras, we should think too nobly of the soul to wish to convert an honest conclusion on the subject into a legal offence.

Among those who are qualified to speak in Great Britain there can be only one opinion: that the attempt to limit the advance of scientific thought is intolerable. History is full of examples which show that progress cannot be stayed, even if it can be

temporarily arrested. It may be anticipated that the principle which is so much feared by a section of opinion in the Southern States will ultimately triumph over its opponents, by the inexorable evolution of a more rational attitude of mind. In the meantime, much harm may be done, and it may earnestly be hoped that the supporters of a policy of intellectual slavery will be defeated.

Ernest Barker, D.Litt.,
Principal of King's College, London.

How far can the public opinion of a State, expressed through its legislature, claim to control the curriculum or the teaching of universities or schools? It would seem to me that any State may demand that this or that subject should be taught in any place of instruction which is supported from public funds, but that no State is entitled to prescribe what should actually be taught about any subject. The reason is simple. The aim of all teaching is to awaken and train intelligence. No teacher can awaken or train the intelligence of his pupils unless he is using his own intelligence freely. If a teacher teaches what he is told to teach, he teaches by rote a lesson which his pupils learn by rote. Without freedom, he is also without self respect; without self-respect, he cannot earn the respect of his pupils; and failing to earn the respect of his pupils, he fails to produce any effect upon their minds. All education depends on the free contact of a teacher, teaching spontaneously, with pupils who are attracted by the suggestion of his teaching and drawn thereby into study on their own account. No man can draw others to himself unless he is speaking from himself.

The very genius of liberty which inspires representative bodies, and is the breath of their own existence, must prevent them from killing the genius of liberty which inspires places of education and is the breath of *their* existence. A legislature cannot be told what it is to legislate; a university cannot be told what it is to teach. Public opinion is a great thing; but there can be no healthy public opinion without discussion, and no genuine discussion without a genuine and free education. If a legislature tries to kill liberty of teaching, it stultifies itself—based as it is itself on freedom of speech. If public opinion seeks to stifle freedom of thought and expression, it commits suicide; for public opinion can only be formed by freedom of thought and expression. A democratic State cannot kill liberty or stifle freedom of thought without killing itself and stifling the breath of its own life.

Prof. D'Arcy Wentworth Thompson, C.B., F.R.S.,
Professor of Natural History, University of St. Andrews.

When the wiseacres of the backward States, with their true herd-instinct, take to quarrelling over whether evolution should be taught or no, it is some consolation to think that worse mischief might perhaps be found for such idle hands as theirs to do. If they did no more than forbid the teaching of evolution in their elementary schools, I should even be inclined to agree with them; for I feel myself none the worse that no schoolmaster ever dreamed of teaching Darwinism to me, nor has it ever been among the lessons which my own children learn. Few schoolmasters are really fit to teach it, and children have other fish to fry.

That these good people should insist on setting the Book of Genesis against the "Origin of Species," and should hate the one as they love (or profess to love) the other, is a sadder thing. The lessons of the last sixty years, the philosophy of evolution itself, should help us all to appreciate them both, and to see in the Mosaic cosmogony as noble a poem as ever was in all the world, and a living monument of profound wisdom and very ancient science. The longer I live the more beautiful it seems to me,—the more beautiful and the more vitally and essentially true. The child cannot understand it all; who is there that can? But if it be withheld from him, he is robbed of part of his heritage.

When democratic licence lets these foolish and fanatical men impose their folly on the universities and play havoc with the public libraries, then our American friends and we ourselves may well be dismayed. Dr. H. F. Osborn and his colleagues are smarting under insult and injury, but the protest they have drawn up is moderate in tone and faultless in expression. I admire the restraint they display under the gross provocation they have received. What they want (but they are too courteous to say so) is "a bridle for the ass, and a rod for the fool's back."

Rev. Eric S. Waterhouse, D.D., M.A.,
Wesleyan College, Richmond, Surrey.

The action of certain American states, which have set a ban upon the teaching of Darwinism, is evidence of a curious but frequently-noted fact that, in theological matters, the newer countries are more reactionary than the old. The great majority of clergy and ministers in Great Britain accept the theory of the evolution of species. It has appeared within recent years that some of Darwin's positions are not likely to be sustained; especially as regards the importance he attached to the accumulation of small variations, and to natural selection. But the main position of the evolution of species, as against the doctrine of the special creation of "natural kinds," is well-nigh impregnably based.

Modern Christianity understands that the cause of truth demands absolute freedom of research and statement. The basis of all scholarship is the belief that truth can be attained. Religion must hold that what is true cannot possibly conflict with it. Unfettered search for truth will involve that mistakes are made and errors are accepted as true. But the same process will in time provide also the remedy. Those who hold that Christianity is true should also hold that no scientific or philosophical truth can be detrimental to it, even though such truth may upset ancient dogmas. Conversely, it follows that anything set forth in the name of science or philosophy which is incompatible with those broad truths to which man's religious experience bears witness is to be suspected. Surely ultimate truth must be such as satisfies all our values, intellectual, moral, æsthetic, and religious.

Prof. J. Graham Kerr, F.R.S.,
Regius Professor of Zoology.

The fact of evolution is one which is now verifiable by the student of even elementary embryology, who can observe for himself the successive stages by which any one of the higher animals evolves out of the simple unicellular zygote. In the case of man himself it can be seen that he is for a time provided with gill-openings in the sides of his neck and that he has other temporary peculiarities which would justify his being classed with fishes were only his embryonic structure known. That the process of evolution was characteristic of the past history of the race, as it still is of the individual, is shown by many paragraphs of geological history—the most beautiful of them all being that provided by the rocks of the American continent chronicling the evolution of the skeletal peculiarities of the modern horse. The only persons who can at the present day have honest doubts regarding the broad facts of evolution are (1) those who are ignorant of such facts as I have indicated and (2) those whose conception of God permits them to regard His records, as inscribed in the rocks and in the embryonic body, as a whimsical series of deceptions. If the legislators of Oklahoma and Tennessee belong to the first of these categories, their opinions may be expected to change with inquiry—and I would indeed recommend such inquiry into the facts of Nature as a charming and delightful relaxation from their legislative labours—but if they belong to the second there is, I fear, little hope of modification of their strange, and as they appear to me, somewhat pagan doctrines.

No doubt it might be argued that the main point at issue is not whether evolution is a fact but rather whether thought is to be subject to the control of authority. We have seen of recent years manifestoes exemplifying such control—emanating it may be from Berlin, or from Moscow, or from Pekin, or it may be promulgated by the governing council of some social or industrial organisation. The effects in the way of hatred and war that are liable to result from such policy have been so amply demonstrated in the past, and are so clearly apprehended for the future, that I find it difficult to believe that its open adoption will find any considerable body of support in the United States.

Prof. R. C. Punnett, F.R.S.,
Arthur Balfour Professor of Genetics, University of Cambridge.

To one who has never set foot on the American continent, it is difficult to suggest the real meaning of the curious outburst against freedom of thought which has made its appearance in the Southern States. That it is anything more than a sporadic phenomenon is hard to believe. The firm outer crust of civilisation which has gradually set through the long centuries may at times show local disruption, especially in lands with little tradition of disciplined thinking. Where the will to ignorance exists, the forces of obscurantism may from time to time break out with sudden violence, but that they will ever engulf the globe seems a possibility as remote as the return of the solar system into the nebular phase. After all, it is in his powers of reasoning that man differs most from other animals, and without them he could neither feed nor clothe himself.

This inherent capacity for rational thinking, without which daily life would be impossible, is surely a sufficient guarantee that obscurantism in the long run will never prevail. If we admit so much, it is all to the good that the greatest possible publicity should be given to the trial of Mr. Scopes. It will lead to some interest in these matters on the part of millions to whom, at present, evolution is nothing but a longish word that sometimes appears in a cross-word puzzle. It will bring them into contact with facts, which are at once the best stimulant to curiosity, and the best antidote to obscurantism. Let us therefore hope that the combined enterprise of the newspapers, railways, and cinemas will lead to the erection of an even larger stadium than that proposed. Though the lawgivers of Tennessee may make the angels weep, they hold out a promise of infinite entertainment to a world that is often rather bored with life.

F. A. Dixey, D.M., F.R.S.,
Subwarden, Bursar, and Lecturer of Wadham College, Oxford.

The growing agitation against the teaching of evolution in several of the states of the American Union is nothing less than astonishing. If there is anything whatever that is well established in the conclusions of natural science, it is the general doctrine of organic evolution. The details of the evolutionary process are still matters of legitimate discussion, but as to the main fact that the present aspect of organic nature is the result of evolution, there is absolutely no question among those who are competent to form an opinion on the subject. But even if the doctrine rested upon a less assured foundation of observation and research than is actually the fact, it is no less deplorable that in a civilised country like the United States an organised attempt should be made to check the process of inquiry into the truths of Nature. Whatever excuse there may have been in former ages for limiting the scope of free investigation, and for visiting with penalties those men who ventured to bring their powers of reasoning and observation to bear upon the conclusions sanctioned by authority, no such excuse or palliation exists at the present day.

The futility of all efforts to impede the progress of scientific discovery has been amply demonstrated, and it might have been supposed that this would have been brought home to the consciousness of all but a few fanatics. That the reality is far otherwise has unfortunately been made fully apparent by the activities of the Fundamentalists in the Southern States of America; and it must be recognised that the forces of obscurantism have increased in certain parts of the North American continent to a pitch which actually constitutes a public danger. The fullest sympathy is due to those men of science in the United States who are striving to rescue their country from the reproach of hostility to the cause of truth and knowledge.

Prof. J. Cossar Ewart, M.D., F.R.S.,
Regius Professor of Natural History in the University of Edinburgh.

The coming trial of Mr. J. T. Scopes reminds one of the case of Prof. Robertson Smith, whose articles on Biblical subjects half a century ago greatly distressed and alarmed the authorities of the Free Church of Scotland. Professors in the Free Church Colleges were required before induction to sign the Confession of Faith, which implied, amongst other things, that they would be guided in their teaching by the first chapter of Genesis. After full consideration, Robertson Smith's articles were adversely reported on by a committee of the General Assembly of the Free Church, with the result that he was removed from his chair in the Aberdeen Free Church College. According to Sir Arthur Shipley, the fight made by Robertson Smith for intellectual freedom made him the "most popular if not the most powerful man in Scotland."

There is no evidence that during Darwin's lifetime any professor in the Scottish universities lectured on the doctrine of evolution; but since 1882 the evidence in support of the origin of species by natural selection has been frequently dealt with by teachers in Scotland. It is doubtless true that for some time in Scotland Darwinism was regarded by some as an "unpleasant apparition." This may be partly accounted for by the fact that in 1882 the president of the Royal Society of Edinburgh was a Scottish judge who had no interest in biology, and partly by the presence of several clergymen on the Council. Fortunately, largely by means of courses of lectures in the University of Edinburgh, on the philosophy of natural history, by the late G. J. Romanes, the alarm which for a time prevailed all but subsided; that any opposition that existed has almost entirely died away was made evident by the popularity of Sir Arthur Keith's recent lectures in Edinburgh on the "Story of Man's Evolution as told by his Fossil Remains."

E. N. Fallaize,
Hon. Secretary, Royal Anthropological Institute.

The attempts to discourage the study of evolution which have been made in certain legislatures of the United States, as well as the impending trial in the State of Tennessee, have naturally aroused considerable interest among anthropologists in Great Britain. A ban on evolution would virtually affect the progress of anthropological science not only in so far as it affects the origin and descent of man, but also as rendering meaningless the conception which serves to give unity and direction to the study of human culture as a whole. The importance of these studies in relation to the general advancement of knowledge needs no emphasis, while any system of higher education which omits to take into account the systematic study of man and his culture is deprived of one of its most important elements as an educational discipline. A generation growing up under a scheme of education thus mutilated would find itself cut off from the general stream of intellectual progress and isolated from the culture of the remainder of the educated world.

On the general question of the relation of the State to scientific inquiry, it is impossible not to deplore a movement which seeks to fetter individual freedom of thought and investigation, and at the same time attempts to justify such interference by submission of the questions at issue, not to a scientific tribunal, but to a court composed of laymen without scientific training, and governed by rules of evidence which have no validity in scientific investigation. Should the obscurantist influences which have promoted this action in the State in question prove strong enough to carry the day by force of numbers, the result will appear derisory to the rest of the civilised world; but unfortunately it will deal a disastrous blow to science in the United States, and indirectly to scientific investigation as a whole throughout the world.

Prof. Sydney J. Hickson, D.Sc., F.R.S.
Professor of Zoology, University of Manchester.

A little while ago a student in my class took the opportunity which an examination afforded to dissent from, and to criticise severely, a view which I had expressed in my lectures.

I took the line of action which I think all my colleagues in this country would have taken of giving him a mark for his answer irrespective of the views he expressed, suppressing an inclination I felt to mark him a little higher for the courage he showed in dissenting from the views held by his examiner.

In a university where the teachers are free to teach, the students must be free also to accept or reject the theories they are taught. Suppression of free teaching must lead to suppression of free learning. The students will leave their high school or university trained in the belief that the theories and conceptions of the universe they have learned are true and that anything else is false. This can only lead to a form of mental stagnation in the generation which it is our duty not only to instruct but also to stimulate to search for truth in the wide fields of science.

In the correspondence which has been published about the Tennessee State law on the teaching of evolution, a great deal has been written about the importance of the liberty of the teacher. With all that we must cordially agree. But let us also plead for the liberty of the taught. Let us insist that in a free country the young men and women should be trained to think, encouraged to discuss, and free to form an opinion. The dogmatic teacher produces dogmatic pupils, and a State that insists upon dogmatic teaching produces a race of citizens deprived of that liberty of thought which is essential for its progressive development.

Prof. J. Stanley Gardiner, F.R.S.,
Professor of Zoology and Comparative Anatomy, University of Cambridge.

In all ages and in all climes men have striven for truth, and in the march of progress men have attained no step after more persistence and suffering than the right to a free utterance of the truth that in them lies. Real religion and science have in common this passion for truth, eternal and indestructible. In its search for truth, science begins with the demonstrable

facts, and from these humbly and gratefully draws conclusions. These are not in the nature of permanent dogma, and, as more evidence is attained, further conclusions are drawn.

Let legislators, who ban the teaching of evolution, think what they are doing, and, above all, whether they will not defeat their own ends. The technique of all teaching prepares the ground for theories of evolution. The biologist teaches facts, but the road for the student has already been paved, and the latter naturally strings these facts together in an evolutionary form. I know no professor of biology who requires to teach the broad theory of evolution, for, with a little knowledge of facts, his students, universally and of their own initiative, deduce it for themselves. What the professor does is to discuss how evolution may have come about, its extent and its limitations, endeavouring thereby to teach his students to think logically, that is, sanely. Applied to life his students find that they have learned the principles, not of militant atheism and communism, but of sane and orderly progress, on the due understanding of which depends the prosperity of States. Let those in authority think well of the advice of Gamaliel: "If this counsel or this work be of men, it will come to nought: but if it be of God, ye cannot overthrow it; lest haply ye be found even to fight against God."

EDWARD CLODD.

THE savants of America need no assurance from their brethren on this side of the Atlantic that they are as one with them in their struggle to maintain the liberty of thought and its expression which are the instruments of progress, the legal suppression of which is the aim of the so-called Fundamentalists. That the theory of evolution is based on a bedrock of facts unshakable has no weight where passion, prejudice and ignorance impel undisciplined emotion. Hence, to this type of mentality, reason appeals in vain. Against this are cited the contents of a miscellaneous collection of ancient writings of uncertain authorship, age and meaning, the interpretation of which has riven Christendom into hundreds of "warring sects." We may envy the Greeks of old, of whom, in his brilliant "History of Freedom of Thought," Prof. Bury says, they "fortunately, had no Bible, and this fact was both an expression and an important condition of their freedom."

The attitude of these obscurantist heresy hunters is clear enough. They hold that belief in evolution imperils the souls of men; hence the fanaticism which would prohibit its teaching. To these malignants no quarter can be given: their fictions and fallacies "debase the moral currency." It cannot, as W. K. Clifford says, "be true of my race and yours that to keep ourselves from becoming scoundrels we must needs believe a lie."

Prof. ARTHUR SMITHELLS, C.M.G., F.R.S.,
Emeritus Professor of Chemistry, University of Leeds.

THE control of education by political or sectarian authority must always involve potential danger to intellectual freedom, but it costs an effort to believe that, at this stage of human history and in the New World, we are in the presence of a serious threat on the part of popularly elected State authorities to use political law for suppressing knowledge of the laws of Nature.

It is to be hoped that the intellectual world of the United States will rise to the occasion, and that its members will undergo any kind of martyrdom rather than tolerate so great a scandal. They may be assured of the sympathy and support of multitudes in every civilised country in resisting this extraordinary recrudescence of a type of persecution which was thought to have passed away for ever with the Dark Ages.

The universities, above all, will be called upon to fight on the side of freedom, and it seems inconceivable that they can show any timidity or any willingness to traffic in compromise. The first rights of a teacher, the cause of science, the dissemination of truth, are assailed once more by bigotry and fanaticism in the seats of authority. It seems superfluous to insist upon the importance of the issue or on the need of an unqualified victory over the powers of darkness.

In recent times voices have been heard proclaiming the doom of our modern civilisation. Let learning go into captivity, and surely enough these prophets of evil will be justified!

Rev. J. SCOTT LIDGETT, D.D.,
Warden of the Bermondsey Settlement, London.

THE agitation about the teaching of evolution in the United States raises most important political, scientific and theological questions. In regard to them all the controversy appears to me to be disastrous. For a State legislature to attempt to decide questions of scientific evidence is fatal to the interests both of truth and freedom. It extends the authority of the State to realms quite beyond its legitimate province, and carries us back to the Middle Ages. From the scientific point of view, the contention that the doctrine of evolution is a "mere guess" is to show complete ignorance of the immense body of facts that have been ascertained, and of reasoning that is securely based upon these facts. What is most injurious of all, however, is the supposition that the truth of Christian Theism depends upon any particular hypothesis as to the method of divine action in creating, or constituting, and in sustaining the universe. The philosophy of Theism is much profounder than this. To many Theists, the attempt to treat God as so external to the universe that His action can only be explained as that of Omnipotence acting upon it from without by mere acts of will, is to run counter alike to the deeper teaching of Scripture as to the organic relation of God to His World, to the deliverances of religious experience properly interpreted, and to any satisfactory philosophy of Theism. It represents the doctrine of Deism, and not of Christianity.

Rev. A. F. DAY, S.J.,
Church of the Immaculate Conception, Farm Street, London.

ALTHOUGH my opinion on evolution lays no claim to being that of an expert, I feel favourably disposed towards the theory and do not regard it, in any moderate form, as necessarily conflicting with the revealed account of Creation. Even if this were otherwise, the

policy of the Southern and Eastern States could never commend itself to those who have learnt lessons from the past. Indeed, one might well defend Urban VIII. *in re* Galileo—as Huxley did—and condemn Tennessee, Oklahoma and Co. in the present issue. Of course, the teaching of advanced evolutionism lends itself fairly readily to being made the vehicle for communicating an anti-religious bias. To endeavour to inoculate unformed minds with such a prejudice would evidently be taking an unfair advantage. Indeed, such conduct is opposed to science as well as to morality. It is out of place, therefore, even with mature pupils; both science and religion should confine themselves to their respective provinces.

If any one wishes to combat any doctrine which he regards as erroneous, he should equip himself for the task from the armoury of sound knowledge. It is not for the legislature to enter the lists. Nor should the State run the risk of even appearing to repress honest inquiry.

Prof. G. H. F. Nuttall, Sc.D., M.D., F.R.S.,
Quick Professor of Biology in the University of Cambridge.

The leaders of thought throughout the world have for centuries been unhesitating supporters of the principle that intellectual freedom should prevail in university teaching. Therefore, the opposition to the principle which we are witnessing in the United States to-day, in the form of legislation against the teaching of evolution, is of a character which must fill us with apprehension for the future of "the land of the free and the home of the brave," and of the ability of that land to continue thus to describe itself. Involuntarily we ask ourselves, "What next? Where will this end? . . . if the ignorant majority can thus impede human progress towards truth." The resolution adopted by the Council of the American Association for the Advancement of Science will assuredly be approved by all competent men of science.

Sir Oliver Lodge, D.Sc., F.R.S.,
Formerly Principal of the University of Birmingham.

The outcry against the teaching of evolution in some of the United States seems so preposterous in Great Britain that the only use we can make of it is to bethink ourselves whether we are not doing, or wishing to do, or have not done, something of the same sort in connexion with a less established region of scientific inquiry. Actual prohibition may be difficult of accomplishment, but a refined system of boycotting, such as has begun in the United States in connexion with the doctrine and facts of evolution, can be applied with greater ease, and has already been effective in restraining recruits and silencing the utterances of some who might otherwise have been willing to testify to what they know of truth in other subjects. Had Sir William Crookes been a university professor it would have gone still harder with him than it did. *Lehrfreiheit* is only granted with limitations; it is tolerated so long as it does not outrage preconceived opinion and introduce discord into a pre-established harmony.

Rev. S. M. Berry, D.D.,
Secretary, Congregational Union of England and Wales.

All those who have enjoyed an education steeped in the spirit of freedom will hope that the threat to that freedom in the schools of the United States may be averted. The idea that teachers should be prohibited from teaching the doctrine of evolution because it is opposed to a certain interpretation of the Biblical account of the Creation, seems to progressive minds on this side of the Atlantic both ludicrous and preposterous. To the minds of all progressive churchmen, any such prohibition would be regarded as a set-back to religious progress and a denial of that liberty of opinion in matters of religion which it has taken centuries to win. That such a threat should come from the United States is history's latest irony.

Rev. H. B. Workman, D.Litt., D.D.,
Senator of London University, Principal of Westminster Training College.

Any attempt to interfere with freedom in the teaching of evolution is wholly reactionary, and is bound in the long run to be prejudicial to religion. Dogmatism, whether by scientists or theologians, should give place to a greater consciousness of the vast regions of the unknown.

Truth and Doctrine in Science and Religion.

THE vagaries of those near to us in kin are proverbially harder to understand than those of strangers, and it is equally true that it is less easy to appreciate the shibboleths of the generations immediately preceding our own than those of a remoter date. It is undoubtedly a fact that the common element in British culture and that of the United States has often served to obscure certain fundamental differences of which the occasional manifestation sometimes amazes and more often bewilders us. The tendency shown by certain State legislatures in America in their attitude towards the doctrine of evolution, which has culminated in the prosecution of a teacher in the State of Tennessee for the use of a text-book in which a reference to that doctrine was included, is indicative of a public opinion of a force and character which it is difficult for us in Great Britain and in these days to appreciate.

Scientific workers on this side of the water are accustomed to meet their American colleagues on an equal footing. They expect to find among them a readiness equal to their own to accept the facts which scientific investigation may bring to light and an equal openness of mind in the discussion of the bearing of such facts upon accepted theory. It has, therefore, come with something of a shock to them to find that a movement upon which they may have looked with some feeling of amusement, and as such may not have regarded more seriously than as a passing phase, is likely to prove an obstinate barrier to intellectual progress and freedom of discussion. Those who have followed the trend of thought among the intellectual section of the general public in the United States for any length of time may not be equally surprised. They have been aware that sooner or later some such question as this was bound to arise. It is not so long ago that a well-known American novelist put before his

public, as a living question of to-day, in the church of an American city, the problems which exercised the readers of "Robert Elsmere," when first that book was published in Great Britain nearly forty years ago.

The problem with which the more advanced section of intellectual America is now confronted is as old as the hills, or at any rate as old as man himself. Every age and every country produces its Socrates and its Galileo. Everywhere the prophets are stoned when speculation or scientific discovery comes into conflict with the emotions of the majority.

In Great Britain, it is perhaps safe to say that the cause of intellectual freedom has been won. It is not likely that we shall witness again a struggle over a purely scientific doctrine, such as that which raged around the controversies of the middle and latter half of last century. It is difficult for a generation brought up in the freer atmosphere which is a result of those fierce encounters, to enter fully into the intensity of feeling which was aroused by the theological disputes of the earlier Victorian era. The famous Gorham case and the heated discussion of questions of church government which it aroused, and the Tractarian movement, were only a prelude to the storm raised by the publication of F. D. Maurice's "Theological Essays" in 1854, repudiating the doctrine of eternal punishment, which forced his resignation of his professorial chair at King's College, London; while the heated arguments over the archæological discoveries of Boucher de Perthes in the Somme Valley, which relegated man to a vast antiquity, merely paved the way for the tempest which followed the application of the Darwinian hypothesis to the problem of man's origin.

The recent celebrations of the centenary of Thomas Henry Huxley have served to recall the many controversial questions in the discussion of which he was a protagonist; of these, perhaps his encounters with Wilberforce at Oxford, and with Gladstone, have remained most firmly fixed in public memory. To his fearless championship of the doctrine of evolution in the stormy years of the 'sixties of last century, following on the publication of "The Origin of Species," is due as much as to any the victory of freedom for scientific inquiry into, and speculation on, the great problems of the origin and development of the forms of life. His conception of the sanctity of truth, and his fearless acceptance of facts whatever might be their bearing upon dogma in any field of inquiry, remain the creed of the scientific investigator of to-day. But that it is generally recognised as right to hold that creed is due to those who bore the heat and burden of that day—Darwin, Huxley, Tyndall and others of their time. Much must be attributed to the force of personality of those who participated in these controversies, and perhaps as much to the writings of one who took no active part in them himself, namely, Herbert Spencer. Spencer's writings, and particularly his sociological writings, by their application of the biological conception and the evolutionary point of view to the study of man as a social being, did much to secure acceptance for the doctrine of evolution among the intellectual public.

Further, in anthropology the work of Tylor in the comparative study of the beliefs of man demonstrated that behind the great religions of the world there lay a long process of growth which could be traced back stage by stage to the primitive animism of the savage, a work which has been extended and confirmed by the labours of Sir James Frazer. At the same time, the studies of the archæologists, in conjunction with the geologists, were extending to more and more remote periods of time, and to an increasingly primitive stage, the evidence for man's existence, in the shape of the primitive stone implements which marked his early efforts to control and shape his environment to his needs. Concurrently, the critical study of the Bible—the Higher Criticism—was demonstrating the composite character of its parts, while its sources—notably the story of the Creation deciphered by Smith from the cuneiform inscriptions—were being derived from other than Jewish sources.

It would scarcely be worth while to recapitulate these familiar facts if it were not to recall that, immediately following upon the formulation of Darwin's theories and their discussion, there was a convergence of evidence bearing upon the origin and history of man and on his beliefs, some of it derived from an extended application of the evolutionary method of study, which by superseding the traditional static view, tended to facilitate if not the acceptance at any rate the preservation of an open mind towards the central problem.

To the scientific mind, perhaps it is a temptation to over-estimate the extent to which the cogency of an argument has appealed to the general public. The freedom in discussion of matters of the intellect which has been won in Great Britain must perhaps in part be attributed to the national temperament. The key may perhaps be found in the writings of Herbert Spencer, the apostle of the individualism which is the most marked characteristic of the Englishman. The appeal to authority which is the negation of the intellectual freedom postulated by scientific inquiry is by tradition and training alien to the British temperament. The nineteenth century in Great Britain was a time of intellectual ferment in the political as well as the scientific world, but in both cases it was the culmination of a movement which had been in being for centuries. The demand for "Civil and Religious Liberty," which was the war-cry of one of the great political parties of the day, was merely the traditional spirit which gave rise to the Reformation, to nonconformity and to the reforms of the Philosophical Radicals at the beginning of the nineteenth century.

It may be that it was by good fortune that the battle of the Darwinian hypothesis and its extension to the evolutionary theory was fought on favourable ground. That for us of to-day is a matter of history. But it lays upon those who hold the torch to hand it on undimmed and to watch jealously that, in changing conditions, no change can affect the unity of free and unfettered discussion in all matters that appertain to the pursuit of knowledge. In these days, when science is universal and co-operation in scientific research transcends national boundaries, it is impossible that what affects a part should not affect the whole. The whole scientific world will therefore watch with no little interest and anxiety the result of a trial which may by its results affect the intellectual progress of one of the great nations of the world. Not only may it stunt the intellectual growth of generations: it may also debar her from all participation in the advancement of one of the most important of the branches of knowledge.

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Biology and the Fur Trade.

DURING the last quarter of a century there has been an enormous increase in the demand for furs. In the United States alone, according to Mr. David C. Mills, the general director of the National Association of the Fur Industry, "the annual catch of fur bearers in the United States was roughly estimated at about twenty-five millions of dollars twenty-five years ago. We estimate it roughly at sixty millions to-day, with quantities fairly well maintained, on the whole, because of the impetus given to trapping by the higher returns to the trapper." But this impetus means more intensive slaughter. How great the slaughter is may be gathered from the lists of skins exposed for sale at the fur auctions during the winter of 1925. The total number of skins (excluding Chinese and Australian) greatly exceeded four and a half millions, and a few of the larger items included: skunk 652,293, American opossum 456,195, musquash 787,195, squirrel 837,097, mole 357,599.

Such destruction of fur-bearers could have but one result; it has involved the usurpation of the annual increase of the animals, and beyond that a trenching upon the capital stock itself to a serious degree. That the destruction has already gone too far in many areas is admitted on all hands. The officials in charge of the Fur Resources Division of the U.S. Bureau of the Biological Survey, from a detached point of view, state (September 1924) that "the fur trader of the past was interested chiefly in the quantity of pelts he could collect . . . and when the dressing of furs became well established as an industry in the United States, the fur trade began to appreciate the fact that some of the more valuable fur animals had almost disappeared from our forests and streams, and that the production of a large part of the most important fine furs was confined to the Canadian Provinces. While the musk rat, the skunk, and, in places, a few other species are left in considerable numbers, the remnants of this once rich heritage in this country are fast dwindling under present-day conditions." The director of the fur industry association, viewing the matter from a business point of view, is equally emphatic (April 1925): "certain species in some districts have been thoroughly trapped out or at least reduced to a point at which they are commercially unimportant. Broadly speaking, the future of the commercial supply of some of the fur-bearing species in all districts is problematical."

Efforts have been made to check the excessive destruction by means of legislation; but legislation labours under special difficulties in these North American territories. Each State frames its own State laws, with the result that there is often a lack of

co-ordination in adjacent regions, expressed in differences in the species of animals protected, in varying methods of protection, and, even when method and species agree, in serious variations in the period covered by the close season, when the protected creature is supposed to be safe from interference.

It is here that biology has a lesson to teach. Knowledge of the life-histories of fur animals and of the biological zones where conditions of livelihood are more or less uniform, should be able to bring order out of the chaos of legislation. It is to biology that both the fur-traders and the officials interested in animal resources look for rescue from the slough into which the fur industry is sinking of its own weight. It is impossible, and only a narrow outlook could regard it as desirable, to put a stop to those interferences with natural breeding grounds—the felling of woods, the draining of marshes, the tilling of the prairie—which are the accompaniments of agricultural progress and of the march of civilisation. The most that biology can do is to suggest how the stock of fur animals can best be conserved, and at the same time yield a full harvest, in these areas where food, shelter, and suitable haunts still exist.

In the first place it is found that trapping of animals is often carried on after the breeding season has set in. This obviously is biologically unsound; for the death of a breeding animal means the loss not only of an individual, but of a prospective adult progeny. Furthermore, it is uneconomic, since the breeding season marks a period when the pelt deteriorates in quality, to the loss of the trapper and the trader. Everywhere the onset of breeding time should mark the commencement of the "close season," and the open season should not commence until the breeding season has ended.

Here another biological consideration comes into force, further to curtail the open season. At the close of the breeding period the pelts are in poor condition, and the fact that many poor pelts reach the market is a clear indication that in places the trapping season is too long. The casting of the old fur and its replacement by a fresh coat is a routine process influenced by specific idiosyncrasy and by climate, but for most animals the time for prime pelt is limited to a comparatively short period in the autumn. Let this, then, be the trapping season, and the markets would gain by a raising of the standard of quality, and the trapper would be better repaid for his labours during a shorter but more intense trapping season.

Lastly, variations in State-to-State laws should be regulated, first by the amount of the stock, upon the annual increase of which the trapper may safely trench without endangering the capital, and, secondly, by the climatic factors which regulate the routine of the life-history. Broadly speaking, a maximum open season would exist uniformly among adjacent States ranged along a climatic, or more strictly a climato-biological, zone, the uniformity being broken here and there by shorter close seasons where the natural stock was at a low ebb.

Such are the biological considerations which the officials of the United States Department of Agriculture are endeavouring to work into the legislation of the States. It is matter for thought that while other countries are approaching this high pitch of perfection in the protection of their native animals, Britain has not yet taken even a first legislative step to protect the waning remnant of its land mammals.

JAMES RITCHIE.

The Chemistry of the Sugars.

(1) *The simple Carbohydrates and the Glucosides.* By Dr. E. Frankland Armstrong. (Monographs on Biochemistry.) Fourth edition. Pp. xi+293. (London: Longmans, Green and Co., 1924.) 16*s*. net.

(2) *Zuckerchemie.* Von Prof. Dr. Hans Pringsheim. Unter Mitwirkung von Dr. Jesaia Leibowitz. Pp. xii+322. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1925.) 18 gold marks.

THERE is at the present time no up-to-date treatise on carbohydrate chemistry. The last edition of Tollens's "Kurzes Handbuch" was published in 1914, the third edition of von Lippmann's "Chemie der Zuckerarten," in two volumes, appeared in 1904, and Maquenne's "Les Sucres" in 1900. Neither of the books before us can claim to be a treatise on the subject, yet they both form useful additions to the literature.

(1) Armstrong's monograph has gone through four editions in fourteen years, a fact which is in itself a testimonial. Besides having been thoroughly revised and the subject matter to a great extent rearranged, the present edition has been enlarged by the addition to the text of some fifty pages, including two new chapters. The author acknowledges his indebtedness to Principal (now Sir James) Irvine and to Dr. T. P Hilditch for giving him many valuable suggestions, as well as to Mr. Rex Furness for assistance in the compilation of the enlarged bibliography.

The opening chapter on glucose outlines the genera character of this typical sugar and its derivatives whilst other chapters are devoted to the chemical properties of the hexoses and pentoses as a class and to the carbohydrate alcohols. Stereoisomerism is ably dealt with, and here the author refers to his own work and to that of Lowry and of Hudson. The di saccharides, tri-saccharides, and the one known tetra

saccharide, stachyose, are also discussed. The chapter entitled "Configuration and Biological Behaviour" is concerned with fermentation, oxidation, selective hydrolysis by enzymes, and the behaviour of sugars in the blood.

The two new chapters deal with hydrolysis and synthesis and with the polysaccharides respectively. In the former the simple law of mass action, illustrated by the rate of hydrolysis of sucrose, is described. The synthesis of sugars *in vitro* and *in vivo* is discussed. Bourquelot's work on synthesis by enzymes is referred to as proving that when this takes place a balanced reaction is concerned. It is pointed out, however, that the work of the author in 1901, and of Hudson in 1914, proves that the system invertase, fructose, glucose produces no sucrose. It will be remembered that Brown and Morris, working with the leaves of Tropæolum, found that the first sugar which could be identified as a result of the assimilatory processes is sucrose. Parkin made a similar observation in the case of the leaves of the snowdrop, and Davis Daish and Sawyer in that of mangold leaves. The first actual sugar to be synthesised is probably a reducing sugar, but the storage carbohydrates are of the nature of sucrose, starch, and the like. Whether sucrose will ever be synthesised *in vitro* must remain an open question; its formation in the plant would seem, however, to be associated with vital processes.

The chapter on the polysaccharides is useful, but it has not been possible to give more than a bare outline of the subject. Pectins and gums are not mentioned.

The chapters on the natural and synthetic glucosides, and on the function of carbohydrates and glucosides in plants, will be read with great interest, containing as they do so many valuable suggestions. Under respiration in plants, a concise account is given of Palladin's theory of respiratory chromogens, whilst Wheldale's work on antho-cyanins is alluded to. In connexion with the tannins, the observations of Kraus and of Busgen that they are structural materials, as instanced by their disappearance from young cork cells, are mentioned, but there is no reference to the work of Drabble and Nierenstein that condensation products giving reactions similar to those of cork are formed by treating a mixture of formaldehyde and phenol or tannin with an acid. This is important as giving a clue to the formation of cork from tannins.

Whilst as a whole the monograph deserves the highest praise, we venture to think that the subject matter might have been better arranged. There is over-lapping, and even repetition, between some of the chapters. This, however, can only be remedied by rewriting and recasting the book; it is unavoidable when an edition has only been revised and extended. The diction is clear and there are no serious typographical errors. We notice one contradiction in terms on p. 47. "In anhydrous alcohol (which, however, contains traces of water) . . ." This is a mere slip, and it is quite clear what the author means. One important feature of the monograph is that it is written in an unbiassed manner. The author states his own views as well as those of other chemists who differ from him on any point. We cordially recommend the monograph to all students of the subject with which it deals.

(2) Prof. Pringsheim's book is intended by him as a text-book for beginners in sugar chemistry. It differs entirely in its lay-out from Dr. Armstrong's monograph, being more in the nature of sketchy outlines on the subject, in which bare facts are stated devoid of full explanation or of suggestion. It is written almost exclusively from the point of view of the organic chemist, the biochemistry of the subject taking only a subsidiary position. Structural formulæ are reproduced freely, but little detail is given of the experimental data on which they are based. It is only just, however, to add that original references are cited in all cases. The author has condensed his subject matter with great skill, but we venture to think that the text has been reduced to too small a compass, for, in addition to the meagre nature of the arguments justifying the theoretical deductions set forth, there are numerous omissions. Obviously, therefore, such a book can scarcely be recommended, without qualification, as a text-book for beginners, who at the present time are too often trained merely to memorise formulæ rather than to study chemistry logically as a branch of experimental science.

The text is divided into twelve sections under the headings: general properties and constitution; oxidation; reduction; condensations; configuration; anhydrous and reducing sugars; amino sugars; synthesis and degradation of the monosaccharides; biochemical reactions of the sugars; the glucosides and their synthesis; disaccharides; occurrence, preparation, and special properties of the most important sugars. A useful feature of the work is the inclusion at the end of each section of tables giving the melting point, rotatory power, and principal derivatives of the compounds dealt with, as well as references to the literature. References to the literature are also given throughout the text as footnotes.

Such criticism as we have ventured to make demands some justification, and to supply this we propose citing some points from the text. Just over two pages are devoted to the pentoses, of which arabinose, xylose, and ribose are briefly described: lyxose is once mentioned.

Of the hexaketoses, fructose and sorbose only are described. It is stated that, according to Hudson's rule, the difference of the specific rotatory powers of the α- and β-aldoses is approximately a constant; this should refer to the difference of the molecular rotations. It is incorrect that starch can be converted quantitatively into maltose by malt diastase, even in the presence of the so-called amylase complement, as the recent work of Ling and Nanji has shown. Nothing is said of Baker's method of preparing maltose by the action of translocation diastase on starch. There is no reference to the cyclic sugars. The obsolete method of Soxhlet of titrating sugars with Fehling's solution in a porcelain dish is described. Following this, however, is a description of Bertrand's permanganate method. Willstätter and Schudel's iodometric method of estimating reducing sugars is described, but there is no mention of the more recent, improved method of Baker and Hulton. Croft Hill's observation that under the influence of yeast maltase (not maltose, *sic*) glucose yields revertose is referred to, but β-glucosido-maltose and isomaltose, which Ling and Nanji have shown to be constant products of the hydrolysis of amylopectin, are not mentioned.

There can be no doubt that, so far as it goes, Prof. Pringsheim's book will be found useful to the student under the guidance of a competent teacher.

ARTHUR R. LING.

Physiological Optics.

Helmholtz's Treatise on Physiological Optics. Translated from the third German edition. Edited by Prof. James P. C. Southall. Vol. 2: *The Sensations of Vision.* Pp. ix+480. (Ithaca, N.Y.: Prof. F. K. Richtmyer, Secretary, Optical Society of America; London: The Hatton Press, Ltd., 1924.) 30*s*.

"IN developing the consequences of any valid general principle in individual cases, one constantly comes on new and quite unexpected surprises. And as the consequences are not arbitrary, nor contingent on the caprice of the author, I have often the impression that it is not my own work that I am writing out, but some one else's."

HERMANN V. HELMHOLTZ.

The text of this volume occupies 468 pages, of which nearly one-quarter takes account of new matter extending beyond the original first-edition treatment; and, of that quarter, fully one-ninth part is specially contributed to the American edition. The contributions of the late Prof. Nagel are a note on the stimulation of the organ of vision by Röntgen and Becquerel rays; another on visual acuity; a section on changes of the retina due to light; a note on complementary colours; one on flicker scotoma; and a large appendix on adaptation, twilight vision, and the duplicity theory. The contributions of v. Kries are a note on contrast, and a long appendix dealing with normal and anomalous colour systems, and with theories of vision. Dr. Christine Ladd-Franklin contributes a new appendix on the nature of the colour sensations.

In his preface to the German edition, Nagel gives his views on the relations of the new work to the older work, as utilised by Helmholtz, in the following words.

"In that region of the 'Sensations of Vision' the main question to be decided first of all was whether Helmholtz's conception of the structure and action of the mechanism of colour perception could still be considered as an adequate explanation of all the new observations that have been made in the last four decades; and if not, whether these ideas should be discarded altogether, or, finally, whether it would be really profitable to introduce here additional supplementary hypotheses. The editor's position on this question is that there is no reason whatever to abandon the fundamental ideas of the colour theory which Helmholtz espoused; although the assumption of the organisation of the mechanism of colour perception in three components is no longer sufficient to give an entirely satisfactory account of all the known facts of colour vision."

Helmholtz so clearly recognised the differences of the rod and cone structures and functionings that, in the first edition of his work, he showed with elaboration (pp. 30, 31, ii., Amer. edn.) that the rods could not act in the same way as the cones, and he considered them to be visually ineffective. The cones he regarded as "the elements that are *peculiarly* sensitive" (italics are ours). Subsequent gain of knowledge gave rise, in the second edition, to the statement that

"From the perfectly analogous anatomical structure of the rods it is extremely probable that they also must have the same sort of capacity; which was the opinion of H. Müller and Koelliker. Nevertheless they must play an entirely different rôle in the localisation of sensations, because, in spite of their being finer and more numerous in the peripheral parts of the retina where they predominate, the power of discrimination between very similar impressions is more imperfect in this region than it is in the fovea."

Since it was known to Helmholtz (second edition) that rod vision is colourless, these statements, if they be not regarded as an actual initiation of those developments of view which have become known as the Duplicity Theory, most certainly pave the way for it. The reticence of his assertions is an example of the characteristic caution and single-eyed aim at the expression of truth which led him to avoid all statements not based on recognised fact. On the whole, from probabilities regarding development of the organ of sight, and also in view of the more recent

investigations, it seems to be most likely that rods and cones are examples of specialisation along a common line, arrest of development towards colour discrimination occurring early in the case of the rods. So that Helmholtz's general scheme of colour vision, including colourless vision as a special case of course, applies throughout the whole range of normal and abnormal vision.

The distinguished developer of the Duplicity Theory, v. Kries, says that "Even at the present time the theory of Helmholtz is thoroughly justified as to its fundamental conceptions," and he corrects "some misunderstandings under which the theory has laboured in many ways." "Fundamentally, the Helmholtz theory was simply the expression of a direct fact of observation, namely, that *the resultant of all the various light stimuli so far as sensations are concerned can be completely represented as a function of three variables*" It is idle to try to explain this fact except on the assumption that the *result of the stimulation* also can be represented completely as a function of three variables." The point may be put even more strongly, for it is the component and resultant *sensations* that are estimated. The equation

$$cC = rR + gG + bB$$

asserts as a fact that the general sensation of type C can be produced by compounding three sensations of independent fixed types R, G, B. It is the psychological trichromasy of all sensations that is asserted. In regard to dichromatic vision, v. Kries says that "the researches have completely verified Helmholtz's conjecture of two main types each due to abstraction of one component fundamental sensation," but he finds difficulty with regard to anomalous trichromasy. The reason is that he overlooks Helmholtz's own use of intertransference, partial or complete, of actions which normally affect one fundamental sensation alone.

This is given with other matters in seventy two precious pages of the second edition, the absence of which from the third is an unfortunate consequence of the adoption of the text of the first edition. Some extracts from the second edition are given. It is regrettable that these pages were not included as an appendix, for they contain the development, by Helmholtz himself, of the trichromatic theory to its highest consummation, in making which he must have had "the impression that it is not my own work that I am writing out, but some one else's."

Dr. Christine Ladd-Franklin gives an account of her views on colour vision, in which she postulates five physiological activities corresponding to red, yellow, green, blue and white. All phenomena of vision can be expressed in terms of five or more activities, but the law of trichromasy, being a psychological law, asserts that only three are independent. The two conditions, $R+G=Y$ and $R+G+B=W$, which she gives, specify the two interconnexions requisite to limit the independence to the observed amount. The outstanding interest of her suggestions lies in the exhibition of a mechanism, which may prove to be the actual one, which satisfies the conditions for restriction of independence, and accounts readily (as also does the developmental view of Helmholtz's trichromatic scheme) for a fused yellow sensation.

The strictures made in the appendices on Hering's scheme are really unmerited. Any condition explainable on the trichromatic scheme can be explained by his with appropriate specifications.

This volume, because of the wealth and importance of the new matter, should be regarded as indispensable by every student of, or worker in, the subject of visual sensation.

W. PEDDIE.

More Torchbearers of Science.

The Torch Bearers. By Alfred Noyes. Vol. 2: *The Book of Earth.* Pp. viii + 375. (Edinburgh and London: Wm. Blackwood and Sons, 1925.) 7s. 6d. net.

MR. NOYES has followed up his first volume of "Torch bearers," which was reviewed in these columns on May 20, 1922, by a second and rather larger book, volume ii., with the sub title of "The Book of Earth." It will be remembered that the first volume was inspired by a night spent in the Sierra Madre Mountains when the first trial was made of the new 100-inch telescope, and it treated of the growth of astronomy from Copernicus to Herschel. It was a notable attempt to carry out the destiny predicted for poetry both by Wordsworth and Matthew Arnold in Great Britain, to express the truths of science in the sort of language which had always served mankind as the vehicle of the highest and eternal ideas. We hailed it as such and are glad to think that the three years since its publication have deepened the public appreciation of Mr. Noyes' effort. The second volume will not be found to belie these expectations. It deals with a much more difficult subject from the point of view of poetic presentation, namely, biology, or rather geology as a preface to zoology and evolution as crowning geology. It leaves one in some doubt as to the scope of the third volume which we are promised in the preface to the first. Is the biology to be completed? Heaven; earth and man would seem to be the natural division. Yet in this second volume we are brought down to Huxley at the famous Oxford meeting of the British Association: so what remains for the third, unless it is to be devoted to relativity and the general

philosophical change in scientific ideas which has taken place in the twentieth century?

It is rather to be hoped that this is not the case, as Mr. Noyes' original instinct was correct: to seek for, and, if necessary, create, dramatic moments to express the onward march of scientific thought. He is least successful in the more abstract parts of his argument, but effective and often moving in his narrative and dialogue.

This second volume begins by thoughts suggested by gazing downward into the Grand Canyon, as the first began by looking upward from the Sierra Madre. The contrast is apt and the field is well chosen from the New World, where land and waters and all the expanses of space are so much vaster than with us. The cantos then proceed chronologically from Pythagoras and Aristotle through the East (Farabi and Avicenna) to Italy with Leonardo da Vinci, France with Jean Guettard, Sweden with Linnæus; and evolution in three cantos, Lamarck and the revolution, Goethe and Darwin.

There are good things throughout, but we will select three as typical of Mr. Noyes' thought in different aspects. The first comes from the second canto, in which the poet imagines a scroll written by Pythagoras and handed by Nicomachus to the young Aristotle as they were walking by the seashore near Stagira. The boy lies down at full length on the rocks and spreads out the papyrus which bids him

> "Guard the immortal fire,
> Honour the glorious line of the great dead.
> To the new height let all thy soul aspire;
> But let those memories be thy wine and bread."

A noble song, sustained through seven verses, and giving the keynote of Mr. Noyes' thought in these volumes, the triumph of new truth found by following the footprints of great thinkers in the past.

Our second extract is from the fourth canto—The Torch in Italy. The subject is a conversation between Giulio, the pure artist, a believer in the absolute and self-sufficient inspiration of the moment, and Leonardo, who does not disclose his identity until the last word. The artist proclaims the independence of the artistic inspiration. "All genius is capricious. You'll admit that men who lived like beasts have painted well."

> "Yet," replies the stranger,
> "For the greatest Art I have always found
> A certain probity, a certain splendour
> Of inner and outer constancy to law."

This is the note which Mr. Noyes has recently developed, so far as poetry is concerned, in his essays in criticism: it is also of the highest moment for his theme in this book, the essential connexion between the right direction of the mind in both science and art. Each aspect is creative of new truth, and neither can attain its fullest realisation without elements belonging more intimately to the other.

The part of the book which will attract the most attention is Canto IX., called "Darwin." This contains the most vivid and moving account ever written of the debate at the Oxford meeting of the British Association in 1860. It is evidently based on the reports of eyewitnesses and is an admirable piece of poetic narrative. The tense excitement of a crowded audience, largely clerics, the determination of Wilberforce to crush Darwin once for all, the postponement of the debate, the ticking of the clock until the moment arrives when Huxley muttered low—"The Lord hath delivered him into my hands." The portraits of all the leading speakers, Henslow, Draper, Owen, as well as the two protagonists, are as good as possible. Then the book winds up with the reaction in Huxley's own mind that night after the triumph of the day. Had not his victory "a relish of the dust"? Had he not used more skilfully the unworthy weapons of his foe? Was there not yet a far larger truth than Darwin had proclaimed and he had so successfully defended? And so on to the Epilogue on "The Eternal Mind which enfolds all changes and can never change."

A remarkable and inspiring book.

F. S. MARVIN.

A Quantitative Study of Regeneration in Plants.

Regeneration: from a Physico-Chemical Viewpoint. By Jacques Loeb. (McGraw-Hill Agricultural and Biological Publications.) Pp. x+143. (New York and London: McGraw-Hill Book Co., Inc., 1924.) 10s. net.

IN view of the sudden loss of Jacques Loeb from the ranks of scientific workers, it is particularly valuable to have in the form of this monograph his own presentation of his views upon regeneration, based upon the long series of experiments he carried out upon Bryophyllum in recent years, recorded so far only in a number of papers in the *Journal of General Physiology*.

In the preface, Loeb states that it is "not more facts which are needed in this field but a method and a principle which allow us to pass from the stage of blind empiricism to the stage of an oriented research." This method Loeb thinks he has found in the study of the quantities of the regenerated tissue by dry weight determinations; the principle he suggests is the simple mass relation thus indicated as determining the amount of regenerated tissue, namely, that it is proportional to the mass of original tissue allowed to regenerate. His point of view brings him sharply into conflict with many views in great favour at the present day, and is

perhaps none the less valuable for that. He rejects entirely the suggestion that wound hormones stimulate new growth, a view much in favour on the Continent under the influence of Haberlandt, and concludes as the result of quantitative studies that the mutilation favours regeneration, because it isolates within a limited mass of tissue, as a severed leaf, a local store of food material which is thus available for regeneration. On the undamaged plant this store would be withdrawn and used for normal growth elsewhere.

The same quantitative attack leads Loeb to another interpretation than that now frequently prevalent, as to the inhibiting action of one growing tissue upon another. Starting from a simple quantitative analysis of the fact that a leaf alone regenerates more freely than a leaf still attached to a piece of stem, he reaches the conclusion that the food supply used for regeneration in the isolated leaf is shared between leaf and stem in the second case, and largely exhausted in growth processes within the stem, including callus formation. He is thus led to reject a view first adopted by him, as is clear from his original papers in the *Journal of General Physiology*, which still seems to emerge in his phraseology when he speaks (in Chapter xii.) of the inhibiting action of the "descending sap from the leaf" upon shoot formation on lower regions of the stem. This inhibiting action he now traces to the fact that the food supply from the leaf is wholly used up in growth processes within the young stem, just as the inhibiting action of an actively regenerating shoot or root upon other shoots or roots later in starting, is put down to the utilisation by the earliest growth centres of all the reserves available for growth. He thus discards the view that the "descending sap" inhibits in virtue of its content in growth-inhibiting hormones (now sometimes termed "chalones").

Loeb's point of view was very physiological, and apparently he never felt the need to work out his conceptions upon a basis of anatomical detail. He was satisfied to interpret his interesting experiments upon the influence of gravity upon regeneration, as showing the movement through the tissues of the plant of soluble substances necessary for growth, so that they collected in the lowest regions and favoured growth there. On experimental grounds he concluded this movement was distinct from the movement of sap in the vessels of the plant, but he never considers further the path by which this nutrient sap moves under the influence of gravity. Again, his experiments upon polarity lead him to the conclusion that the *anlage* of the regenerated shoots and roots must lie in different regions of the plant, but he makes no reference, for example, to the detailed anatomical investigation of cases of regeneration from leaves, in which it has been shown that shoots may originate from epidermal cells whilst roots always arise from cells in the neighbourhood of the vascular cambium.

Loeb's experiments may be in many respects open to criticism; one criticism already made has been that Bryophyllum plants do not always behave like Loeb's plants. But there can be little doubt that Loeb has placed on record a series of valid quantitative data which do supply some guidance as to the phenomena involved in regeneration, and though their complete interpretation will require much further work, involving correlated studies in anatomy, cytology, etc., Loeb has once again blazed a pioneer trail in his steadfast insistence upon quantitative work in a field which is almost obscured with descriptive qualitative details.

Relativity and the Metaphysician.

The Tyranny of Time: Einstein or Bergson? By Charles Nordmann. Translated from the French by E. E. Fournier d'Albe. Pp. 217. (London: T. Fisher Unwin, Ltd., 1925.) 10s. 6d. net.

ALL our life we have looked with awe on metaphysics; its problems are so abstruse and the meaning of the metaphysician's solutions so difficult to understand. Occasionally a doubt arises in our mind whether metaphysics is empty words with no reality behind. But we always suppress the doubt. For how could a subject be mere empty words which has held such an exalted and honourable position through all the ages from the brilliant era of the Greeks down to our own times.

Then comes Einstein's doctrine of relativity. The aim of the metaphysician is to take the laws of Nature, including those provided by mathematicians and physicists, and fuse them into an intelligible whole. It is, therefore, incumbent on him to understand Einstein's doctrine. Even if he rejects it, he must first understand in order to be in a position to reject it. A study of the treatment of relativity by different metaphysicians brings us a little nearer to the answer to our question whether they deal with words or with realities.

The first group treat the subject with all the understanding of the mathematician. It is, in consequence, open to us to believe that those portions of their work that are beyond our understanding are equally sound, and our respect for them continues.

Another group find all the knowledge of the doctrine that they need in the word "relativity." The name reminds them of Bishop Berkeley, who believed in the relativity of the external world in the sense that that world existed only if there was a conscious mind present to perceive its existence. This group is content to identify Einstein's doctrine with Berkeley's.

A third group have studied Einstein's doctrine and

have failed to understand it, and, at the same time, are unconscious of their failure. The author of the book named above belongs to this group. The object of the book is to decide between Einstein who teaches that the simultaneity of two events is relative, and Bergson who holds Einstein to be wrong and simultaneity to be absolute. The author's conclusion is that both of them, as well as every other writer he mentions, are wrong, sometimes if not always. He tells us that Einstein's original exposition, published in 1905, is perfectly correct, but that he is a bad populariser and that his little book, "Über die spezielle und die allgemeine Relativitätstheorie gemeinverständlich," is wrong, and that poor Bergson was led astray through reading the popular account only. He then proceeds to give what he calls an improved and correct popular account, and throws in (page 185) the modest disclaimer: "In making this attempt I do not, of course, wish to put myself above Einstein."

Actually the author is floundering in the bog of his own misconception of Einstein's meaning, one of his mistakes being failure to distinguish when Einstein is engaged in overthrowing the classical theory and when he is stating the theory which is to take its place.

The contemplation of the second and third groups of metaphysicians compels us to conclude that in some cases the discussion is of empty words with no underlying reality, and that we shall be wise to exercise discretion in all cases as to the acceptance of the metaphysicians' conclusions.

Nor was any other conclusion to be expected. Consider the magnitude of the task the metaphysician undertakes. His aim is to fuse all knowledge into an intelligible whole. To do that he must first make himself acquainted with all knowledge. It is true that he needs only general principles and may ignore details, but even so the mass of knowledge at the present day makes it an enormous task. Moreover, that is not the worst, for he must keep abreast of developments in all subjects, and developments of importance are taking place to-day in many subjects. We can only admire his courage and leave him to it. D. B. M.

Folklore in India.

The Folklore of Bombay. By R. E. Enthoven. Pp. 353. (Oxford: Clarendon Press; London: Oxford University Press, 1924.) 14*s.* net.

MR. ENTHOVEN'S book will be welcomed by those who require a very full synopsis of the folklore of the Bombay area. He has gathered together a vast mass of items which he has classified under subject headings—such as worship of natural objects, tree- and snake-worship, spirit-possession, totemism and animal-worship, evil-eye, dreams and omens, etc. Under each category he cites a large number of beliefs and practices, the material having been partly collected by himself and partly derived from the works of others, such as B. A. Gupte and Sir J. Campbell. The compilation of this material must have involved much labour and search. The value of such a "corpus" of facts is evident, and the volume will prove an important reference-work.

The facts are simply stated for the most part, without elaboration; and there is little attempt to diagnose and explain the underlying motives which have dictated the beliefs, rituals, and customs recorded. Such interpretation would have added much to the interest and usefulness of the book; but the author may, no doubt, have realised the difficulties attending any attempt to probe the "true inwardness" and origin of superstitious beliefs and practices. Natural reticence on the part of the natives, coupled, as it usually is, with actual ignorance of the original, and even the present significance of their observances, militates against accurate diagnosis on the part of the researcher, and satisfactory explanations are not easily found. Mr. Enthoven's long residence in India gave him opportunity for seeing below the surface, and his views upon the *raison d'être* of many of the, seemingly, more inconsequent practices and beliefs which he describes, would have been welcome. At the same time, it must be admitted that long residence is liable to instil caution, by revealing difficulties and pitfalls which are hidden to the tenderfoot, and to cause the experienced Western student to realise how ill-equipped he really is to probe and analyse the mentality of Oriental peoples. Recognition of obstacles difficult to surmount may have acted rightly as a deterrent, and have induced the author to abandon the open, speculative game and to play for safety.

The *comparative* study of superstitions has done much towards suggesting explanations of folk-phenomena, and will surely lead to further results. The object of the author of this volume is, however, to deal with the subject from a descriptive and not a comparative point of view. The book makes available for the student an extensive, classified collection of *data*, concerning in the main a single, if extensive, area; and it has an intrinsic interest, as reflecting the culture-status of the people within that area. This collection of facts will be appreciated by the comparative folklorists and ethnologists, who can collate the local material with similar phenomena recorded from other regions, and can study the whole on a broader basis. The book would have had added value had the author given in all cases the sources whence the items of information were collected. References are, unfortunately, few, and it would have been of interest to

know the extent to which the author's own observations have played a part in supplying material for this interesting volume.

A useful appendix has been contributed by the late Dr. William Crooke, in the form of a *questionnaire* on folklore. This enumerates many of the chief topics upon which information is needed, and should prove of considerable service to those residents who are anxious to increase our knowledge of the peoples among whom they live. The field-student should be warned that, in pursuing his investigations, *direct questions* should be avoided at all costs. HENRY BALFOUR.

Our Bookshelf.

Geschichte der Rübe (Beta) als Kulturpflanze von den ältesten Zeiten an bis zum Erscheinen von Achard's Hauptwerk (1809). *Festschrift zum 75jährigen bestande des Vereins der Deutschen Zuckerindustrie.* Von Prof. Dr. Edmund O. von Lippmann. Pp. vi + 184. (Berlin: Julius Springer, 1925.) 12 gold marks.

PROF. E. O. VON LIPPMANN, Director of the Zuckerraffinerie, Halle, to whom we are indebted for such a vast quantity of accurate information upon the history of chemistry, has now written a book which will interest not only those engaged in the sugar industry, but also botanists, chemists, and agriculturists. It is unnecessary to say that this latest production is characterised by the same sound scholarship and exhaustive research which marked the "Entstehung und Ausbreitung der Alchemie."

The earliest mention of the mangold appears to be in the "Acharnians" of Aristophanes (455–388 B.C.?). It is described by Theophrastus in the "Historia plantarum," and was certainly cultivated by the Greeks. Among the Romans, again, the plant was well known and is mentioned by Cicero, Catullus, and others. Since species of Beta grow wild on the North African shores of the Mediterranean, it is possible that turnips and mangolds may have been known to the ancient Egyptians. Whether this is so or not, they were common in Egypt at the time of Alexander the Great (3 B.C.), and are often mentioned by the Alexandrian chemists of the third to fifth centuries A.D.

In later times, turnips, mangolds, and beetroot were widely cultivated, and Prof. Lippmann takes his story up to the beginning of the nineteenth century. Although he modestly says of his book, with Luther, *Exemplum vobis dedi ut plura faciatis*, he has obviously searched the available literature with great care.

E. J. H.

Coal and Civilisation. By Prof. Edward Charles Jeffrey. Pp. xvi + 178. (New York: The Macmillan Co., 1925.) 10s. 6d. net.

The work may be considered as consisting of two parts, namely, a description of coal, its origin and structure on the one side, and the application of coal in the service of mankind on the other. The former is of great interest and contains much novel matter, as might be expected from so distinguished a botanist as Dr. Jeffrey. The second theme is, however, very indifferently handled and forms a sad contrast to the former. Dr. Jeffrey has evidently failed to appreciate the real effect of coal upon the history of civilisation; thus he repeatedly urges that British supremacy in the eighteenth century was due to the application of mineral fuel to the smelting of iron, but entirely overlooks the far greater issue, namely, that almost simultaneously the steam engine was developed in Great Britain, thus for the first time pressing latent energy into the service of mankind, which had up to then been forced to rely upon kinetic energy only. The author's technical knowledge of the subject is also not so sound as it might be. For example, he states that brown coals are treated "by briquetting with suitable binding media," whereas the chief value of brown coal lies in the fact that it is capable of being briquetted without the use of a binder.

In respect of the structure of coal and of the plants that enter into its composition, the views of Dr. Jeffrey are important and instructive; it may, however, be suggested that he seems inclined to put too much stress upon the fresh-water origin of coals and to have somewhat neglected the evidence of marine conditions. It might have been expected that the Delta theory of Fayol would have received some attention; Dr. Jeffrey is a convinced supporter of the view that coal is the product of plant remains transported to the waters in which the organic matter was deposited, but scarcely deals effectually with evidence contradicting that view, such as that afforded by the existence of under-clays with stigmarian rootlets.

An Introduction to Psychology. By Prof. Hugh A. Reyburn. Pp. v + 324. (Cape Town: Maskew Miller, Ltd., n.d.) n.p.

THIS is an attempt to compress a protean subject into 316 small pages, and, on the whole, a successful one. The fact that a well-chosen and comprehensive bibliography of 52 works follows the 16 chapters shows that the author recognises that his "Introduction to Psychology" is an introduction and nothing more, but it is no mere summary of what is already known, being very definite as to points of agreement with, and dissent from, other authorities.

The introduction of new terminology, always to be feared when opening a work on psychology, is avoided, and where there would otherwise be the possibility of doubt as to the application of any term, the context renders the meaning intended unmistakable.

Prof. Reyburn defines his subject as "the science of immediate experience." He does not, however, deal with objective manifestations to the neglect of the subjective, but attaches a good deal of importance to introspection. All that is most valuable in modern psychological schools of thought has been utilised or incorporated, but the extremist views of Freud and the behaviourists are not supported. A fear is expressed in the preface that the section containing an account of the nervous system may prove too long, but a closer condensation than the succinct summary given would scarcely be possible. Indeed, an amplification of the paragraph dealing with the cerebral cortex would be a desirable addition to future editions. It is rather remarkable that in a work on psychology containing much clear reasoning and sound judgment, the terms reasoning and judgment are not given even an indical reference.

Isis: International Review devoted to the History of Science and Civilisation; Official Organ of the History of Science Society. No. 21, Vol. VII (i.), 1925. Pp. 168. (Soc. Anon. M. Weissenbruch, 49 rue du Poinçon, Bruxelles.) Annual subscription, 26*s*.

ALTHOUGH *Isis* has become the official organ of the recently founded History of Science Society, it is happily still edited by Dr. George Sarton, its originator. The present number maintains the high standard which has been set by its forerunners, and the width of its appeal may be judged from the fact that it includes contributions from Essen, Rome, Madison, Belgrade, Amherst, and Montpellier.

Two articles of special interest are those by Prof. A. J. Hopkins on "A modern theory of alchemy," and Prof. Émile Turrière on the history of glass-making in western and central Europe from the Middle Ages to the end of the eighteenth century. Prof. Hopkins's theme is that the alchemists, far from failing in their quest, were successful, since their conception of "gold" was very different from ours. "The reason why we cannot follow the alchemistic theory or look upon those conceptions with sympathy is that the alchemist, like the artist, was stressing the changeable Aristotelian qualities where we stress weight and fixed qualities. . . . The alchemist fitted theory to practice and succeeded far beyond the realm of probability. According to his definition of 'gold' transmutation *was effected*. The alchemist obtained what he wanted." Although this theory of alchemy is not so novel as Prof. Hopkins appears to imagine, it has never received proper consideration. Yet it obviously explains much that is obscure, and Prof. Hopkins is to be congratulated upon having set it forth so clearly and logically.

Narcissus: an Anatomy of Clothes. By Gerald Heard. (To-day and To-morrow Series.) Pp. 156. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1924.) 2*s*. 6*d*. net.

THREE mottoes face the table of contents of this book, two from "Sartor Resartus" and one from Michael Angelo. The analogies they draw between life and clothes, the body, and architecture and its products, are worked out in detail. The author takes the line that psychology having resolved to treat nothing in its province as insignificant, clothing, now regarded as unimportant, may be assumed to be of racial significance, as a phase of the evolution which started on new lines when man emerged. Mr. Heard regards both clothes and architecture as parallel manifestations of an evolutionary force, tracing them from the beginning of weaving and the use of woven wattle for walls in the neolithic age, through Egypt, Mesopotamia, Crete, the classical period and historical times, down to the ferro-concrete building of to-day and modern costume, where development apparently has ceased. Fanciful though the analogy may seem, it is perhaps not extravagant to assume that racial character manifesting itself in two media so entirely different may still exhibit a certain convergence in style so far as conditions allow. After a certain stage, however, the standardising, more or less, of all modern communities is unlikely to offer much play for racial individuality, however either clothing or architecture may develop.

Tales from Nature's Wonderlands. By Dr. William T. Hornaday. Pp. xii + 235 + 24 plates. (New York and London: Charles Scribner's Sons, 1924.) 12*s*. 6*d*. net.

FORTUNATE indeed are the children who can claim the author of this book as grandfather and exact from him, as a grandchild's privilege, the charming stories here published. The author has covered a wide range of subjects, from the origins of the American fauna to life in the deep sea, from the American mammoths to the lung fishes of Australia, from giant monster reptiles of Hell Creek to the penguins of the Antarctic Continent, from the forests and jungles of India and Borneo to the mountain crags of the Canadian Rockies and the ice-bound Polar Seas. In all he is equally happy, interesting and vivid, telling his story in simple compelling language well calculated to stir the imagination of children. It was a happy thought to publish these stories from Nature's book, so simple and so scientifically accurate, and we would wish, with Dr. Hornaday, that all our young people should become acquainted with them. The photographic illustrations are good, and materially help towards a proper understanding of the text.

Chambers's Encyclopædia: a Dictionary of Universal Knowledge. New edition. Edited by Dr. David Patrick and William Geddie. Vol. 6: Hume to Manche. Pp. iv + 872. (London and Edinburgh: W. and R. Chambers, Ltd.; Philadelphia: J. B. Lippincott Co., 1925.) 20*s*. net.

THE latest volume of this convenient encyclopædia maintains the high standard of the work. The articles have been revised or re-written, and many new articles have been added. References to books published within the last few months are not infrequently included. There is a liberal allowance of excellent coloured maps, besides a number of smaller black and white maps, and many illustrations and diagrams. The encyclopædia is to be completed in ten volumes.

Outlines of a Philosophy of Art. By R. G. Collingwood. (The World's Manuals.) Pp. 104. (London: Oxford University Press, 1925.) 2*s*. 6*d*. net.

IF this manual has a fault, it is not that it is ill-done but that it is done too well. The author has instilled into his account of art a complete philosophy of life. Perhaps it was impossible to separate the two, but it demands of the reader a more than usual concentration of his attention. On the other hand, any one who wants a clear and concise account of Croce's æsthetic doctrine will find it admirably presented in the first chapter.

Traité de psychologie. Par Prof. Georges Dumas. Tome 2. Pp. 1173. (Paris: Félix Alcan, 1924.) 60 francs.

THIS is M. Dumas' second volume of an extensive survey of recent work in psychology. Though named a treatise, it is in effect an encyclopædia. It is a collaboration of the leading French psychologists, each of whom has been invited to write a dissertation on the special subject matter of his own research. It is a valuable work of reference, with a detailed bibliography attached to each section.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Preliminary Note on the Transmutation of Mercury into Gold.

THE experiment on the transmutation of mercury was begun in September 1924, with the assistance of Messrs. Y. Sugiura, T. Asada and T. Machida. The main object was to ascertain if the view which we expressed in NATURE of March 29, 1924, can be realised by applying an intense electric field to mercury atoms. Another object was to find if the radio-active changes can be accelerated by artificial means. From the outset it was clear that a field of

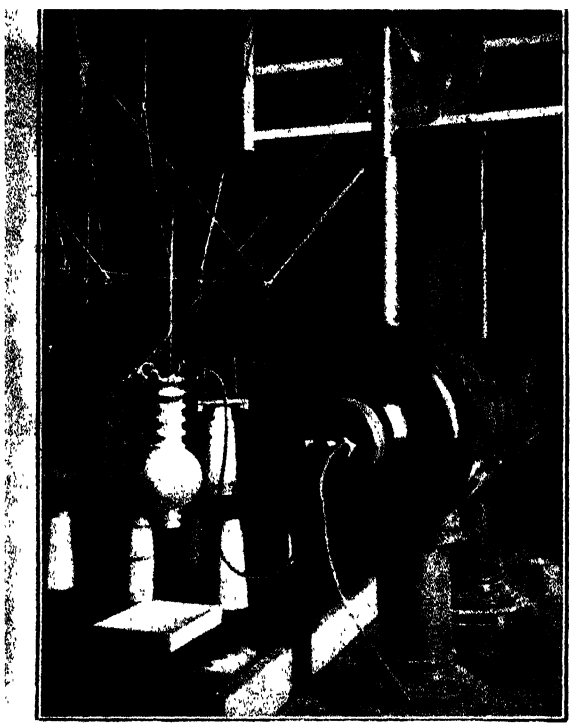

FIG. 1.—Apparatus for the electric discharge. Discharge vessel is supported on four glass tubes.

many million volts/cm. is necessary for the purpose. From our observation on the Stark effect in arcs of different metals (*Jap. Journ. Phys.* vol. 3, pp. 45-73) we found that with silver globules the field in a narrow space very near the metal was nearly 2×10^6 volts/cm. with terminal voltage of about 140. The presence of such an intense field indicated the possibility of obtaining the desired strength of the field for transmutation if sufficient terminal voltage be applied. Though the above ratio of magnification would be diminished with high voltage, the experiment was thought worth trying, even if we could not effect the transmutation with the apparatus at hand.

Fortunately an induction coil of 120 cm. spark length, made by Klingelfuss, was available for the purpose (Fig. 1). For keeping the terminal voltage between the electrodes sufficiently great with a short spark gap, the discharge was conducted in paraffin oil, in which a potential difference of about 15×10^6 volts/cm. can be maintained. With iron and purified mercury as electrodes, the discharge appeared at first as arcs, and the spectrum was continuous; it gave rise to abundant production of gases and carbon particles from the oil; the mercury gradually turned into fine globules, until the oil and mercury were mixed into a black pasty mass. We cannot definitely say whether the intense field observed during the experiment on the Stark effect was present during the discharge or not, but it is probable that mercury atoms have been acted upon by strong electric force during the violent bombardment, as the discharge is of an analogous nature. Continuing the discharge for about four hours, the product was examined chemically for gold by the test of Cassius'-purple; the result was decidedly positive. This experiment was performed on September 15, 1924; on succeeding days experiments were repeated, and two days after, Mr. Yasuda, an expert in gold assaying, showed us minute gold specks extracted from the black mass obtained in the experiment of the previous day. Grave doubts were, however, expressed by critics as to the purity of the mercury and also as to the possible presence of traces of gold in the chemical laboratory, due to frequent treatment of the metal.

To clear away these doubts, the mercury to be used in the experiments was first purified by ordinary chemical means, and then subjected twice or thrice to vacuum distillation, care being taken not to raise the temperature above 200°. The mercury, oil and chemical reagents used in the experiments were carefully examined by making blank tests. A room in the physical laboratory was allotted to the chemical experiments. Succeeding experiments confirmed the result, but the glass vessel was too fragile to pass the heavy condensed discharge, and it exploded during the process. Bushing insulators were tried, but the tube was too narrow, and the discharge passed into the walls. A discharge vessel of about 2 litres capacity with walls of 2 cm. thickness, provided with a long neck and a short tail for inserting the electrodes, was designed and made ready for experiment in the beginning of May. During these intervals, minor tests were made with the porcelain flask on the mode of discharge, the oil to be used for the process, the material of one of the electrodes, and easy means of detecting the presence of gold.

As we found in our investigation on the Stark effect, it is always advisable to insert condensers in the discharge circuit. We used bushing condensers of many glass plates with thin lead plates between them, the total capacity being about 0·002 microfarad. As the discharge potential is very high, the condenser plates are apt to break, and must be so large that discharge between the end plates does not take place in air.

As iron contains many impurities, we found that tungsten wire, free from thorium oxide, which we obtained through the courtesy of the Tokyo Electric Company, is the best on account of the small corrosion during the discharge.

As to the method of testing, the formation of ruby glass is delicate and in most cases accompanied by the separation of gold particles at the centre or outside boundary, which can be observed with a metallographic microscope, by using reflected light.

A special distilling flask was designed for the purpose of separating carbon, oil, and mercury from the residue in the discharge vessel, after bombarding the mercury for 10 to 15 hours. Paraffin, kerosene, and transformer oil can be used, but the last seems to be the most suitable.

The gold obtained from mercury seems to be mostly adsorbed to carbon. Ruby glass is formed by heating small pieces of glass with the carbon; in the process now used it is formed in numerous spots on the walls of the distilling flask by repeatedly heating it to about 600°. We have often separated mercury by washing the oil with benzene and ether, and after separating it from carbon by centrifugal separator, distilled it in vacuum and examined the

FIG. 2.—Ruby glass by transmitted light. ×150.

residue, which generally contained no gold, but a minute quantity of white metal, which may probably be another product of heavy discharge; it was, however, too small to be tested chemically.

The accompanying illustration (Fig. 2) shows a spot of ruby glass photographed with transmitted light and magnified 150 times. The central dark portion contains gold particles distributed as shown in Fig. 3 taken with reflected light and magnified

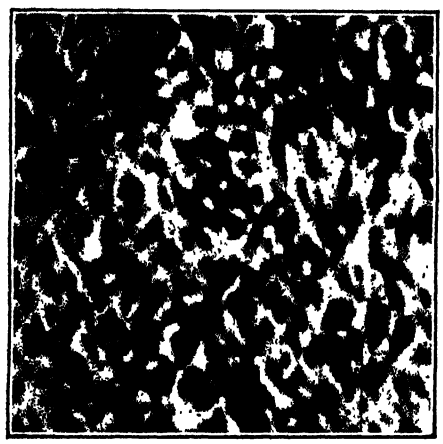

FIG. 3.—Ruby glass by reflected light. ×2500.

2500 times. It represents only a small part near the boundary of the central spot. The white ring is greenish blue, and the lightly shaded one is rosy; these colours are characteristic of gold colloids. Numerous spots of this kind are obtained in the bottom of the distilling flask during the after-treatment of a mixed mass of carbon and mercury after heavy condensed discharges. Sometimes ruby glass is apparently covered with a thin film of gold; on microscopic examination it is found to consist of fine particles of gold very densely distributed. The primary current in the induction coil in such experiments ranges from 25 to 30 amp., and the spark length in air is more than 1 m.

Probably we could produce the same effect by using lower voltage, if sufficient capacity were inserted, but the resistance of the vessel is not great enough to withstand the heavy discharge, especially when carbon and mercury are intimately mixed together. The construction of a proper discharge vessel seems at present to be a difficulty in getting an amount of gold sufficient to determine its atomic weight. Which of the isotopes of mercury is changed into gold can perhaps be inferred from the atomic weight. Spectroscopic examination will be started so soon as we can obtain sufficient material for the purpose.

The process taking place may be looked upon as due to commotion in the nucleus by intense electric force. If we assume that Coulomb's law ceases to hold within the nuclear boundary, the positively charged protons form a compact core, and the electrons within the boundary surround it. On applying an external electric field the motion of the core is opposite to that of the electrons, so that if the field be sufficiently strong, it is possible that some of the electrons may pass out of the nuclear boundary, and if the core be not very stable, some of the protons constituting it may get out. The commotion thus introduced by the external force will have some resemblance to radio-active disintegration, which must be attributed to the internal commotion of the nucleus. An experiment was made with ferro-uranium, to see if the radio-active process cannot be accelerated by applying a strong field, but owing to the ionisation it was difficult to maintain the field for a sufficient length of time. An investigation of the process of accelerating the disintegration must, therefore, be reserved for future experiments.

The experimental procedure here sketched cannot be looked upon as the only one for effecting the transmutation; probably different processes will be developed and finally lead to industrial enterprises. At present, there is no prospect of producing gold economically from mercury. Experiments with various elements may lead to different transmutations, which will be of significance to science and industry. Meagre as is the result, I wish to invite the attention of those interested in the subject so that they may repeat the experiment with more powerful means than are available in the Far East.

H. NAGAOKA.

The Institute of Physical and Chemical Research, Komagome, Tokyo, May 26.

The Quantum Explanation of the Zeeman Triplet.

IN his letter published in NATURE of June 27, p 978 Prof W M Hicks raises some interesting points in connexion with the quantum theory of the simple Zeeman effect. As Prof Hicks points out, the theorem of Larmor's usually taken as the basis of the theory does not define in any manner the relation between the orbits on which the rotation is superposed in the presence of the field on one hand, and the corresponding orbits before the imposition of the field on the other. The supposition that these two sets of orbits are identical is, therefore, in no way justified on the basis of Larmor's theorem alone. It can, however, be shown from purely classical considerations (see G A Schott, "Electromagnetic Radiation," Cambridge University Press, 1912, §302, p 317) that, to the first order in terms involving the field, the two sets of orbits are identical. Schott's proof takes into consideration the induction

forces which act on the moving charges during the period of establishment of the field, whereas Larmor's theorem confines itself to the so-called Coriolis forces which, as Prof. Hicks points out, act transversally on the moving charges, and hence cannot alter their energies.

Prof. Hicks proves in a simple case that the application of the Wilson-Sommerfeld quantum conditions to the Bohr hydrogen atom with reference to fixed axes (instead of the special rotating axes employed in the usually accepted theory) leads to no Zeeman effect at all as a first approximation. A more general proof of this was given in a paper of mine about two and a half years ago (Roy. Soc. Proc., A, vol. 102, 1923, p. 529) in which I also put forward an alternative theory of the simple Zeeman effect which seems to me to answer Prof. Hicks's purpose. The theory is based on a slightly extended form of the quantum conditions which was first suggested by Prof. William Wilson (Roy. Soc. Proc., A, 102, 1923, p. 478), namely

$$\int_0^{\tau_i} dq_i = n_i h,$$

where $\pi_i = p_i + eA_i$,

p and q being the usual Hamiltonian co-ordinates, e the charge on the particle in question, and A the generalised magnetic vector potential. These conditions are applied both in the absence and in the presence of the field, thus defining the orbits and their energies in both cases, and the frequencies are then obtained from the energy relation $\Delta W = h\nu$. It is also shown that the relation between corresponding orbits defined by the extended conditions (*i.e.* orbits for which the quantum numbers are the same) is in complete accord with Schott's theorem; in fact the latter is derived as a necessary consequence of the quantum conditions themselves.

A. M. MOSHARRAFA.

The Manor House,
Alkrington, near Manchester, June 18.

THE objection of Prof. Hicks to the use of Larmor's principle (NATURE, June 27, p. 978) is well founded, but the Zeeman triplet effect can be made to fit into the quantum theory by keeping strictly to dynamical principles. The phase-integral $\int p dq$, for a variety of reasons, is, for the case of a magnetic field, to be replaced by $\int (\delta L/\delta \dot{q}) dq$, where L is the Lagrangian function. For the hydrogen atom

$$L = \tfrac{1}{2}m(\dot{r}^2 + r^2\omega^2) - \tfrac{1}{2}He r^2\omega/c + e^2/r.$$

Hence, on quantising,

$$mr^2\omega - \tfrac{1}{2}Her^2 = nh/2\pi.$$

From this, for radial quantisation,

$$m^2\dot{r}^2 + n^2h^2/4\pi^2r^2 = 2e^2m/r + 2mC',$$

where $C' = C + nhe/4\pi mc$, C being the energy and H^2 being neglected. Hence the "permitted" values of the energy is

$$-(2\pi^2me^4/h^2)/(n + n')^2 + nhe/4\pi mc,$$

where n, n' are the azimuthal and radial quantum numbers.

ARTHUR W. CONWAY.

Abbeyview, Dalkey, Co. Dublin,
June 27.

The Oogenesis of Lumbricus.

IN a letter to NATURE (June 27, p. 979) Prof. J. B. Gatenby objects to certain comments upon his work made recently by Mr. L. A. Harvey in a paper on yolk-formation in the earthworm (*Q.J.M.S.* 69, p. 291). Mr Harvey is a student working in this department and it is on his behalf that I wish to protest against the tenor of Prof. Gatenby's letter. It is quite evident that Prof. Gatenby has not comprehended clearly the contents of Mr. Harvey's paper; for his letter contains misstatements, and these may do a considerable amount of harm unless speedily contradicted.

Prof. Gatenby accuses Mr. Harvey of having been discourteous in saying that a glance at a paper of his (Prof. Gatenby's) summarising what is known about the formation of yolk shows that "really very little is known" on the subject. Mr. Harvey was perfectly justified in making this statement—it is simply a statement of his opinion—and on this point I am in complete agreement with him. The fact that Prof. Gatenby disagrees with the statement does not make it discourteous. The paper referred to, Prof. Gatenby complains, is an "old one." Its actual date is 1920, and if the advance since then is represented in Dr. Brambell's paper (1924) on "Yolk," to which Prof. Gatenby refers, it can safely be said that any advance made has been extremely small.

The remarkable objection is then made that Mr. Harvey, in studying yolk-formation in Lumbricus, is not justified in inferring any conclusions as to the similar process in Limnæa—a form studied by Prof. Gatenby. He gives no reason in making this statement. However, he previously refers to a paper by a student of his as containing an account of *Molluscan* oogenesis. Actually it deals with two forms and those both gastropods, and hence any general conclusions drawn must have been inferred from the study of those two forms.

Prof. Gatenby suggests that before criticising his work Mr. Harvey should have repeated it. While I admit that repetition might be desirable, it is obvious that Prof. Gatenby has failed to grasp Mr. Harvey's criticism, which is, not that his observations are at fault, but that his deductions are. This is made perfectly clear on p. 292.

Prof. Gatenby's next point is that it was unfortunate that the egg of Lumbricus was chosen for the study of yolk-formation, as it contains no "real yolk." This is incorrect. Yolk *is* present in the egg, and the criteria used for the recognition of that yolk were those advocated by Prof. Gatenby himself. This is fully explained on p. 299. Further, Prof. Gatenby objects that Lumbricus is a "special atypic annelid" and yet refers to Saccocirrus (apparently) as a typical annelid.

It is the static conception of the cell to which Mr. Harvey objects. He regards it essentially as a dynamic concern—an equilibrium system in which the constitution of each constituent is a function of its surroundings—and because of this he considers that the technical methods and the reasoning adopted in modern cytological investigations into the question of yolk-formation are wrong. If Prof. Gatenby had read more carefully the introduction to Mr. Harvey's paper he would have grasped this, and, in that event, it is to be hoped, would not have written his letter.

H. GRAHAM CANNON.

Zoology Department,
Imperial College of Science,
South Kensington, July 2.

Transmission of a Rosette Disease of the Ground Nut.

THE important part played by insects in the dissemination of the virus diseases of plants is now recognised, and experimental proof of transmission by particular insects exists in a number of cases. As a result of investigations during the past season, we are able to add one more to the list of those diseases of which the insect vectors are known.

During recent years the cultivation of the ground nut or peanut (*Arachis hypogea*, L.) in parts of South Africa has been seriously handicapped by outbreaks of a disease locally known as "rosette." The leaves of an affected plant are small, twisted and closely crowded, owing to the non-elongation of the internodes of the stem, giving the plant a bunched or rosetted appearance. These leaves are generally yellow, but in many cases show definite mottling. No seed is set by a plant diseased at an early stage of growth; and the yield is materially reduced by late infection.

We believe this rosette disease to be identical with the East African "krauselkrankheit" of Zimmermann ("Der Pflanzer," 1907 and 1913), with the Javan "krulziekte" of Rutgers (Dept. Landbouw, Nijv. en Handel in Nederl. Indie, Meded. v/h Instituut voor Plantenziekten, 1913), and with the "bunching" or "clumping" recorded from West Africa and India.

All investigators of this disease failed to attribute it to any parasitic organism or in fact to any definite cause, and its nature remained little understood. Zimmermann (1907) directed attention to a similarity between this disease and tobacco mosaic; more recently, the comparison was rendered the more obvious by extensions in our knowledge of the plant virus diseases, so that pathologists generally assumed that the peanut rosette disease belonged to the virus group. Support to this view is now afforded by experimental transfer of the disease. Work carried out under our direction at Pretoria and independently at Durban has demonstrated the ability of *Aphis leguminosæ*, Theo., to transmit the disease. In these experiments aphids, removed from rosetted peanut plants, were allowed to feed upon a single mature leaf of a healthy plant, suitably protected from the feeding of any other insects. The characteristic rosette symptoms appeared afterwards in the young leaves of a large proportion of these plants. Control plants, receiving identical treatment but protected from the feeding of any insects, remained healthy.

During the course of this work, collections were made of all the suctorial insects occurring upon diseased peanuts in the field. Tests of more than two hundred individual jassids and fulgorids belonging to at least eight species afforded no single infection of the experimental plants.

H. H. STOREY.

Natal Herbarium, Durban.

A. M. BOTTOMLEY.

Division of Botany, Pretoria.

X-ray Stimulation of Phosphorescence of Fused Silica.

WITH reference to the recent correspondence in NATURE on the properties of silica, the following experiments on its phosphorescence after exposure to ultra-violet and X-rays may be of interest. In the course of experiments to test the supposed fluorescence or phosphorescence of castor oil after exposure to ultra-violet light, it was found, working independently, that a photographic plate was blackened when exposed to the oil if the vapour were allowed to come in contact with it. If, however, the vessels containing the oil were carefully sealed no blackening was obtained, even when the oil had been previously exposed to ultra-violet light. The vessels containing the oil were sealed glass jars having polished natural quartz lenses as windows, the exposure to ultra-violet radiation being carried out in these vessels.

A fused silica weight thermometer exposed to the X-rays from a "Shearer" tube for periods varying from half an hour to several hours, and then placed in contact with a photographic plate, produced considerable blackening whether containing oil or not, the fused silica being responsible for the whole of the effect, since oil exposed to X-rays, and then transferred to a quartz vessel after treatment, would not produce blackening.

The polished lenses of natural quartz previously employed could not be stimulated with X-rays or ultra-violet light to actinic phosphorescence, but experiments have shown that various specimens of fused silica can be made to phosphoresce, and, moreover, may be seen in a dark room to fluoresce a faint green under the direct action of the X-rays, the luminosity apparently ceasing with the cutting off of the radiation.

The silica continues, at room temperature, to give off radiations for periods up to three weeks or a month after the original exposure to X-rays, but the phosphorescence is removed by heating to redness for two minutes.

F. L. HOPWOOD.

W. V. MAYNEORD.

Physics Dept.,
Harvey Laboratories,
St. Bartholomew's Hospital, E.C.1.

The Sound of Lightning.

SINCE my letter on the above subject in NATURE of May 23, several other instances have been brought to my notice. Mr. W. H. Dines has heard the sound six times certainly, and probably more; Mr. J. S. Dines has heard it once, as has also my brother, Capt. A. L. Cave, in London, when he was indoors; two other correspondents also write to say that they have heard the sound, one of them three times. But perhaps the most remarkable case is that given in the *Marine Observer* for July (page 112); Capt. J. Burton Davies of s.s. *Hurunui* reports that from 10 P.M. on July 30, 1921, to 3.45 A.M. on July 31, when in about lat. 38 N. and long. 71 W., "a terrific electric storm was playing about the ship. . . . On three occasions the officer of the watch and myself were momentarily completely dazzled by flashes, and it appeared that immediately before the flash we heard a tearing noise as of canvas being ripped violently; in fact, after the first of these flashes I caused the quartermaster to inspect the boat covers on boat deck to see if any were torn. This noise interested me very much." The fact that the noise was heard before the flash seems to indicate that it may have been caused by a brush discharge. In any event, it proves that the noise must be real, and not an illusion like the rushing noise that some have imagined they have heard when watching a bright meteor, or the rustling sometimes attributed to the aurora.

C. J. P. CAVE.

Stoner Hill, Petersfield,
July 2.

Ether Drift and the Relativity Theory.

IN reply to Prof. Eddington's letter in NATURE for June 6 (vol. 115, p. 870), it will be enough to state that the type of ether motion alluded to in my first letter on this subject is, in spite of appearances, strictly *irrotational*. For all details and the literature of the subject the reader may be referred to my paper on "Stokes-Planck's Aether" in the *Phil. Mag.* for February 1920, p. 161. The irrotationality of Lorentz's solution to which the said motion corresponds is there sufficiently emphasised.

LUDWIK SILBERSTEIN.

Rochester, N.Y.,
June 29.

The Royal Observatory, Greenwich.

THE Royal Observatory was founded in the reign of King Charles II. to assist in the solution of the important and difficult question of determining longitude at sea. The use of the method afterwards known as "lunars" had been suggested. As the moon moves round the sky in a month, its position among the stars changes rapidly: if, then, an almanac can be prepared giving the position of the moon among the stars according to the time of some fixed place, say Greenwich, the navigator can by observation of the moon determine the Greenwich time. It is an easy matter to determine his local or ship time, and the difference gives the longitude. In the seventeenth century the movement of the moon was not known with nearly sufficient accuracy for this method to be available, and even the positions of the fixed stars were very imperfectly charted. The Royal Observatory was founded to remedy these defects, and Flamsteed, the first Astronomer Royal, was charged to make observations for "rectifying the tables of the motions of the heavens and the places of the fixed stars so as to find out the so much desired longitude at sea, for perfecting the art of navigation."

At the suggestion of Sir Christopher Wren the site for the Observatory was chosen on a hill in Greenwich Park. A grant of 500*l*. was made by the King, bricks were obtained from a disused fort at Tilbury, and the Observatory was built according to the design of Wren by Sir Jonas Moore, Master-General of the Ordnance. The foundation was laid on August 10, 1675, and the building completed in the following year.

The Rev. John Flamsteed was appointed Astronomer Royal at a salary of 100*l* a year, but he was not provided with any instruments. He brought with him an iron sextant of 6 ft. radius, and Jonas Moore lent him a smaller one and two clocks. The use of clocks as part of an observatory equipment dates from about this time. Flamsteed made repeated appeals, but in vain, for money to erect an instrument in the meridian, which, he was convinced, would give greater accuracy and was essential for referring the position of the stars to the equinox. In 1683 he erected a mural circle at his personal expense, dividing it with his own hands. This instrument was not very satisfactory, but in 1688, as he was in better circumstances, he had a larger one constructed for him by Abraham Sharp, at a cost of 120*l*. Sharp was his friend and assistant, and the two worked together for several years, determining the position of the equinox, the obliquity of the ecliptic, and the positions of sun, moon and stars. The "Historia Coelestis," which contains an account of his methods and results, was published partly by himself and completed after his death by Abraham Sharp in 1725. It may be noted that Flamsteed was one of the first astronomers to use telescopic sights in his observations, as he was one of the first to make use of clocks. His observations were a great advance on those of earlier astronomers, though they are now only of historical interest. His catalogue of the positions of more than 3000 stars was corrected early in the nineteenth century by Francis Baily, who remarks that Flamsteed's British Catalogue is one of the proudest productions of the Royal Observatory.

On the death of Flamsteed in 1719, he was succeeded by Halley, the friend of Newton, who secured the publication of the "Principia." He rendered many services to science, but is best known for his prediction of the return of the comet to which his name was afterwards given. When Halley came to the Observatory, it was without instruments, as Flamsteed's executors had claimed those which he had used. In 1721, Halley installed a small transit instrument. Although the design is open to criticism, the instrument is of interest as the earliest specimen of a very important type. In 1725 he had a large iron mural quadrant constructed by Graham. With his instrument he made many observations, particularly of the moon.

Bradley succeeded Halley in 1742. From his observations at Wanstead he had discovered the aberration of light in 1729. He continued his observations for many years and announced the discovery of nutation of the earth's axis in 1748. With the help of his nephew, who was appointed his assistant, he commenced observations with Halley's instruments. He applied for funds for new instruments, and on the recommendation of the Board of Visitors, seconded by the Council of the Royal Society, was granted 1000*l*. by King George II. With this money he obtained an 8 ft. brass quadrant, and a transit instrument of 4½ ft. focal length and an object glass of 2·7 inches. These were both made by Bird. He also obtained a clock by Shelton, which is still in use at the new magnetic station at Abinger.

With these instruments, Bradley laid the foundations of modern astronomy of position. His skill in the design and use of his instruments rendered his observations far more precise than those of any of his predecessors. The observations were collected and reduced after his death by his friend Hornsby. They were later re-reduced by Bessel in his "Fundamenta Astronomiae," and again late in the nineteenth century by Auwers. Our present knowledge of the direction of the sun's motion in space, and the existence of two star streams, is largely dependent on proper motions derived by comparing later observed positions of stars with those found by Bradley.

Bradley's successor, Bliss, lived only two years after his appointment and was succeeded by Maskelyne in 1764. Maskelyne had been sent at Bradley's suggestion to observe the transit of Venus at St. Helena in 1761. He made practical application during his voyage of methods of determining longitude at sea by lunar observations, and soon after his return published the "British Mariner's Guide," the forerunner of the "Nautical Almanac," which commenced in 1767. These works gave precise directions and presented astronomical data in the simplest and most suitable forms for their application to navigation. During the forty-four years of his tenure of office, he was very assiduous in the observation of sun, moon, planets and a small number of the brighter stars, being specially attracted by the problem of determining the position at sea, to which the Observatory owed its origin. His famous expedition to Schiehallion to determine the mean density of the earth was made in 1774. Towards the end of his life he found that the quadrants of Graham

and Bird needed to be replaced. Pond, from observations made at Westbury in 1801–1806, had shown the advantage of using a complete circle instead of a quadrant. Maskelyne gave instructions to Troughton for the construction of an instrument of this form, but did not live to see the completion of this beautifully designed and excellently divided circle.

On the death of Maskelyne in 1811, Pond was appointed Astronomer Royal. The mural circle made by Troughton, and the transit instrument made by the same great artist in the year 1816, were the greatest improvements in astronomical instruments since the time of Bradley. A second circle by Jones was added in 1825. Pond introduced the method of observing stars by reflection in mercury with one instrument while they were being observed directly with the other. On the following night the rôle of the two instruments was changed. Pond's observations were of a very high order of accuracy, so much so that Chandler traced in them the small changes caused by variation of latitude. His Catalogue of 1112 stars was a most valuable contribution to the accurate determination of stellar positions. Pond was also able with these instruments to show that several alleged discoveries of parallax of stars of the order of about 1″ were incorrect. Another benefit which the Observatory derived from Pond was an increase in the number of assistants from one to six, resulting in a considerably increased output of observations.

Airy succeeded Pond in 1835 and retired from his post in 1881 at the age of eighty. His contributions to optics, tides, metrology and many practical questions are outside the scope of this article. He introduced into the Observatory very orderly and business-like methods of reduction of observations and their regular and prompt publication. Of the new instruments which he installed, the transit circle erected in 1851 has been the most valuable. Its use led to a great increase in the number of observations. He introduced the use of registration on the chronograph, a method invented in the United States. He also introduced the system of telegraphic transmission of time daily from the Observatory to the General Post Office for distribution over Great Britain. The great equatorial, erected in 1860, with a 12·5-inch object glass by Merz, was for a time the largest refractor in England. Airy's reduction on a uniform system of the lunar and planetary observations made by his predecessors since the time of Bradley was a great contribution towards the formation of accurate tables of the movements of sun, moon and planets. He extended the scope of the Observatory by the introduction of magnetic and meteorological observations.

Christie succeeded Airy in 1881 and retired in 1910. During his tenure of office, photographic observations became a part of the regular work of the Observatory. The daily photography of the sun, and measurement of the position and size of the spots, was actually begun in Airy's time but was developed considerably by Christie. A share was taken by Greenwich in the photographic chart and catalogue of the heavens, and for this purpose the astrographic telescope was obtained. Additions to the equipment were made in the 28-inch visual equatorial, used mainly for observations of double stars; in the altazimuth, essentially a transit instrument which can be placed in any azimuth; and in the Thompson equatorial, consisting of a 26-inch photographic refractor and a 30-inch reflector, the gift of the eminent surgeon Sir Henry Thompson. The large increase in the buildings and instruments made in Christie's time were very necessary for the Observatory to maintain its high position. A great extension took place in the output of the Observatory in meridian astronomy. The part assigned to Greenwich in the astrographic chart and catalogue was carefully carried out. A thorough determination was made of the solar parallax by observations of Eros. Valuable series of double star observations were made with the 28-inch telescope, and the two telescopes of the Thompson equatorial were employed on a variety of problems.

In conclusion, it may be truly said that the original intention of the founders of the Observatory has been carried out consistently for 250 years. The pursuit of the practical problem of the determination of longitude has involved long series of observations which have contributed very largely to our knowledge of the movements of sun, moon and planets. At the present time a larger share is given to questions of purely astronomical interest, but the practical applications of science are still interwoven with them in observations of position of sun and stars, the distribution of time, the care of the Navy chronometers and the compilation of magnetic charts. F. W. D.

Problems of the Rhone Delta.[1]

By R. D. OLDHAM, F.R.S.

IV.

WHEN, in 1711, the Rhone broke away from its former course to the sea, it more and more adopted the new channel until, in 1724, the older one was definitely closed to navigation; the river, following the course it still maintains, had established its channel to the sea-face, and in 1725 the town of Arles complained of the difficulties of the new mouth, where extensive sand-banks had formed. The river, in fact, having reached the open sea, was subject to conditions which are described in reports of the nineteenth century; the deposit of silt, where the current is checked on reaching the sea, combined with the effect of the waves in sorting and casting back the coarser grained material, together with the absence of any tidal scour, led to the formation of low sand-banks, known as *they*, barely emerging from the water when the sea-level was low, and submerged when it was raised by a river flood or an onshore wind. The main channel of the river was blocked by a well-defined bar, on which the water might reach a depth of a couple of feet, but was mostly under a foot, and through this bar a narrow and constantly changing pass admitted, in favourable circumstances, vessels of up to 6 feet, but usually not more than 4½ to 5 feet, in draft. Only in fine weather was this

[1] Continued from p. 54.

narrow channel practicable, and for 120 days in the year the passage was too dangerous to allow of any vessel entering or leaving the river; even when the channel was otherwise clear, vessels might find that it had shoaled too much to admit them, and have to tranship their cargo into lighters of shallow draft.

Various attempts were made to overcome these difficulties. The first was the construction of a canal from Arles to Port de Bouc, but the dimensions of the canal were too small to render it serviceable. The next scheme was to restrict the river to a single narrow outlet, in the hope that the scour of the current would

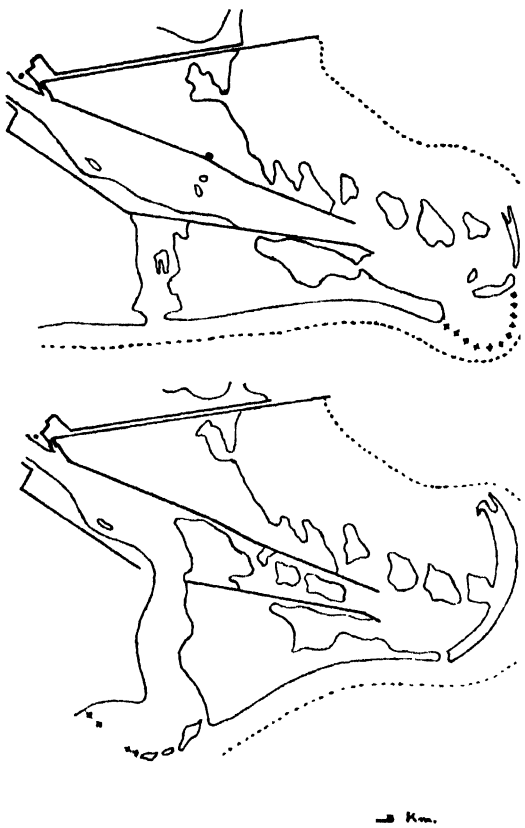

FIG. 5.—Mouth of the Rhone in 1893 and 1913. Dotted line marks the contour of 5 m. depth of water.

maintain a deep channel, and in 1852–55 embankments were carried along both banks to the mouth, the last of the lateral outlets being closed in 1856. At first, success seemed to have been attained, the channel deepened to 12 feet, but in a couple of years a new bar had formed, further out, and the channel shallowed to its old depth of 4 to 6 feet. This plan having proved a failure, it was decided to cut a ship canal from the Gulf of Fos and form a port on the river near the Tour St. Louis, and by 1871 the port and canal, with its locks, were completed. This proved a modified success, the Port of St. Louis established itself as one of the principal of the minor ports on the Mediterranean coast of France, and would doubtless have attained greater prosperity but for malaria, with which this part of the delta is infested.

Meanwhile the mouth of the Rhone had been advancing south-eastwards at a rate of about 60 metres a year, and threatened to block the fairway to the Port of St. Louis, so it was decided to reopen the Grau de Roustan, which had been the principal lateral outlet of the river on the western side. In 1893 the embankment with its stone revetment was removed, and a narrow cut opened to the river through the land which had been formed since the embankment was made. This cut, as was expected, was widened by the river, which rapidly adopted this channel as its main outlet to the sea, the previous main channel becoming more and more blocked with sand-banks. At the end of twenty years a complete change had come over the mouth of the Rhone. The channel of 1893 had been almost completely filled up, only a narrow and shallow channel remaining; the low *theys*, the bar at the mouth, had been washed away by the sea, and a continuous barrier of dry sand, crowned with sand dunes, formed at about 700 metres behind the previous position of the mouth. The old Grau de Roustan had become the sole outlet of the river, which had built up new land to 1200 m. in advance of the old shore-line, and the mouth was blocked by a row of *theys* and a bar, like that which had formerly blocked the mouth of the river, and such as will always be formed where a silt-bearing river enters an almost tideless sea.

It is of some interest to compare this description of the conditions at the mouth of the Rhone, in the nineteenth century, and the measures undertaken to overcome the difficulties, with the accounts which we have of the campaigns of Caius Marius in 103–102 B.C., in the course of which he encountered the same difficulties and adopted similar measures to overcome them. Plutarch, in his life of Marius, says that the mouth of the Rhone being barred and almost filled up with sand and mud, the passage became narrow, difficult, and dangerous for the ships which brought provisions; so Marius, bringing his army, drew a great trench and, by turning a great part of the river, brought it to a convenient point on the shore where the water was deep, and this still retains the name it took from him. To this account Strabo adds that, after the defeat of the barbarians, Marius gave the canal to the people of Marseilles, who derived great revenue from tolls on ships passing along it, notwithstanding the entrance continued difficult to navigate, on account of the deposits and the flatness of the country, so that in foul weather the land could not be discerned, even when one was quite close.

The account which these writers give of the entrance to the Rhone shows that conditions were the same as in the nineteenth century, and suggests that what Marius did was analogous to the solution arrived at some 2000 years later, when the St. Louis canal was dug; and Strabo's account of the difficulties which arose, in later times, is matched by the formation of sand-banks, and a bar, across the Grau de Roustan, when that became the main channel of the Rhone. The digging of a canal a mile and a half long, or very likely less, would not have been too great a work for an army to undertake in the time at his disposal; once dug, access would be made easier for a while, but in course of time, as the river abandoned its old course and adopted the new one, all the difficulties and dangers of the entrance to the river would reappear. That no trace of this canal

remains is not to be wondered at; the river continued to bring down silt and extend the delta for eight centuries after it had been dug, and then came the subsidence which caused any trace of the work of Marius, necessarily lying near sea-level, to be buried under twelve to fifteen feet of silt or water.

During the last two centuries, in which the river has been building up the projection from the old sea-front of the delta, which has reached a length of about 9 kilometres, and has added nearly 40 square kilometres to the area of the delta, changes of a different character had been taking place farther west. The river, during the period in which it had flowed in the channel of the Vieux Rhône, had built up a prominence of some four or five kilometres, but as soon as the course of the river had changed, and the transport of fresh material had ceased, this prominence was attacked by the waves of the sea, and rapidly removed. Opposite the Faraman lighthouse, the recession of the sea-front amounted to about 4·5 kilometres between 1710 and 1870, after which equilibrium seems to have been nearly established and recession became slow. The material removed from this part of the coast was mainly swept to the westwards, where part of it went to form the projection of the Pointe de Beauduc, but part was drifted round the point, to form the continuous barrier and sandy beach which borders the Golfe de Beauduc. Maps of the seventeenth and early eighteenth centuries show no trace of this, the Pointe de Beauduc is not indicated, and the Golfe is bordered by an archipelago of islands, separated by channels, open to the sea and penetrating inland to the Étang de Vaccarès. The date at which these conditions were altered, by the formation of a continuous beach and barrier along the coast, cannot be determined with precision, but in the Cassini map, constructed in the 'seventies of last century, the barrier is shown, and the sea-face is almost as mature in form and outline as on the most recent maps, so we may put the transition, from the immature to the mature form of the existing sea-coast, as having taken place round about the close of the eighteenth and the commencement of the nineteenth centuries.

This completes the cycle of changes which this region of the Rhone delta has undergone, since definite information commenced with the advent of the Romans. At the outset, the extent and outline was not materially different from that of the present time, but the land stood about fifteen feet higher above sea-level than nowadays, the extensive salt lakes and marshes were all dry land, and the Camargue was a fertile, populous, and prosperous region. Along the sea-coast there were probably lagoons, separated from the sea by a continuous barrier, sand dunes and sandy beach, which swept round the coast in smooth and even curves, characteristic of a mature coast-line. At the mouth of the river, which lay farther west than the present mouth, a projection had been formed by the alluvium brought down by the river, exactly analogous to that which has been built up along the present channel. These conditions continued during the rise and fall of the Roman dominion in Gaul until, in the eighth and ninth centuries, a subsidence of the land took place, by which not only were the low level deposits along the coast and at the mouth of the river plunged beneath the sea, but a larger part of the higher ground behind them was also brought below sea-level. The matured coast-line disappeared and was replaced by the immature condition of an archipelago of islands, and the river, instead of debouching in the open sea, ended far inland in a land-locked inlet of shallow water. Then, for some eight centuries or so, the river was occupied in filling up the submerged areas of the delta, and in pushing forward its mouth until, about the middle of the seventeenth century, it again reached the sea-front, and about a century and a half later the continuous barrier and beach, with the curved outline of maturity, was again established. Along the sea-coast the delta had resumed the general type, and approximately the outline, of earlier times, but, in the interior, large areas of what was then dry land are still occupied by salt water lakes and marshes, which have been protected, by accidents of surface configuration, from the deposits of the river, and still remain much as they were left at the close of the period of subsidence.

Evolution and Intellectual Freedom.

SINCE going to press last week, we have been favoured with several further messages on the subject of the campaign in the United States against the teaching of the principle of biological evolution. We are glad to be able to publish these expressions of opinion upon the attempt thus being made to restrain intellectual freedom and progressive thought. As to the trial now being held at Dayton to test the validity of the anti-evolution law of the State of Tennessee, there can be no question that leaders in all departments of intellectual activity in Great Britain regard it with amazement. It is not for us to suggest that a teacher was justified in breaking the law of a State of which he was the paid servant, but what does astonish us is that the citizens of the State should tolerate a law which makes references to evolution and the descent of man illegal. So far as actual teaching of these subjects in schools is concerned, most men of science would not insist upon attention being devoted to them; but when the ban extends to colleges and universities, the matter becomes of prime importance.

There can be no research for truth in Nature if natural truth, including that of the creation of the universe, the earth, and man, has to be regarded as revealed, once for all, in the Biblical record. It would be impossible for any teacher of science to be true to his intelligence and yet give instruction under such conditions. There is, fortunately, no probability of limitations of the kind advocated by Mr. W. J. Bryan and the Fundamentalists being placed upon biological teaching in Great Britain; and for the sake of human progress, we trust that the reactionary movement which they represent will fail of its object. The attack has come from the advocates of traditional doctrine and not from workers in scientific fields, who ask only to be free to extend natural knowledge by research and instruction, without being bound by the words of any master. No one supposes that the problem of organic evolution has been solved, but of the fact of evolution there is not the slightest doubt, and only by further inquiry can we understand fully its course and significance. Whatever Mr. Bryan and his followers may

insist upon as regards belief, science declines to accept finality in the position of natural knowledge at any epoch, or to construct a standard which all discoverers must follow. As Huxley said, when unveiling Darwin's statue in the Natural History Museum, South Kensington, in 1885, science "commits suicide when it adopts a creed."

We need scarcely say that it is not our wish to have a discussion in NATURE upon Genesis and modern science, or religious belief and scientific evidence. Our sole object in taking up the subject of the prohibition of the teaching of evolution in certain States of the United States, and in inviting opinions upon this action from a number of leading authorities, has been to afford support to our colleagues fighting for scientific truth and progress against dogma and stagnation. We trust that the additional messages subjoined will give them the strength and courage they need to secure for them the position of intellectual freedom established in Great Britain many years ago, and existing unchallenged to-day.

Prof. J. GEORGE ADAMI, M.D., F.R.S.,
Vice-Chancellor of the University of Liverpool.

NOTWITHSTANDING "Main Street," it is difficult for us in the old country to realise the state of public opinion throughout the greater part of the United States outside the larger cities: difficult to realise how the minister (be he Methodist or Baptist, Congregationalist or Lutheran) and the Sunday School dominate the community. In the small country town and every village aspires to be a town—there is no society, and no public opinion, save that centring round one or other church. He is out of society who is not a church member, and it is a commonplace for "Aunt Susan," a representative of one of the oldest families in the town, to conduct the Sunday School class, she being close upon seventy, and her class consisting of the elderly farmers of the locality and their wives and associated elderly spinsters, who have, as it were, grown up under her wing. Visit the farms and other houses of the town and you will find no solid literature that is not theological of an approved type, and of that but some three or four books. Read the local papers and you will see in them little beyond local news, of church teas and picnics, of auctions, of local weddings and funerals in most intimate detail, with a long column of notes upon the doings of local personages, how this one has left for New York or that one returned from Chicago, with, of course, full information regarding local and league doings in baseball. They contain absolutely no news about the outer world, no discussion of topics outside the range of the Sunday School. Save personal gossip and local happenings, all other topics are taboo.

The "Aunt Susans" and their elderly classes in their turn dominate the minister. For his peace of mind—and bread and butter—he dare not venture beyond the bounds of the teaching delivered over long years by Aunt Susan. All the leaders of the community would be scandalised and up in arms. They pay him, and he has no security of tenure. As a consequence an intellectual stagnation and aridity, a narrowness of outlook and a supreme confidence that opinion in Pumpkin Corner is the only possible and only right opinion, unbelievable as they are to us, are actualities throughout Tennessee and agricultural North America.

It is this that makes possible and that explains the proceedings which have led to the Dayton trial. It is this state of affairs that explains the lack of theological progress which in itself is adequate to explain the situation in Tennessee, Oklahoma, Florida, and many other States.

It is eminently likely that in the trial at Dayton the arguments for and against evolution will not be reached. There is a matter yet more fundamental, politically speaking, than that upheld by the Fundamentalists, namely, the constitutional right to fetter liberty of thought. It is a question of supreme moment whether in the "Land of Freedom" the Tennessee decision does not contravene the Declaration of Independence and the basal right of every citizen of the United States to a reasonable liberty.

Prof. C. LLOYD MORGAN, D.Sc., F.R.S.,
Emeritus Professor of Psychology, University of Bristol.

THROUGH the courtesy of the Editor of NATURE I am permitted to enrol my name among those who wish to express their sympathy with advocates of the free and untrammelled spread of evolutionary teaching throughout the length and breadth of the United States of America.

I am one of those who believe that all advance in the order of Nature of which we ourselves, body and mind, are constituent parts exemplifies evolutionary progress. This may be true or it may be false. If it be true, no legislative authority can suppress it; if it be false, it will not be through legislative authority that its falsity will be demonstrated.

But I am also one of those who believe that there are thousands in America and elsewhere who find in evolution a stay and support of their deepest religious convictions. If this be so—if, as I think, it be plain matter of history vouched for by these thousands of religious people—the position, as I see it, is this: by excluding evolutionary teaching in the schools and colleges of this or that State, an avenue to the full and free development of religious faith and observance is arbitrarily barred by legislative enactment.

Unless those who attend these schools and colleges differ markedly from those young folk with whom I have been for many years acquainted in England, there will always be a certain percentage who will find that the form of theological doctrine, whatever it may be, that is prescribed under authority is such as they cannot honestly accept. In my experience a large proportion of these honest and perplexed young people scarcely know what evolution means. When they have learnt what light it may throw on the problems that perplex them, they rejoice in their new sense of freedom from the bondage that has been enforced by authority.

The Right Rev. H. HENSLEY HENSON,
Lord Bishop of Durham.

IT is difficult for an educated Englishman, and *a fortiori* an educated English clergyman, to regard the proceedings in Tennessee without astonishment and contempt. The scientific theory of evolution, popularly associated with the name of Charles Darwin, has

established itself so firmly in the acceptance of all serious students in Great Britain as to be rather an axiom of thinking than a specific doctrine. Of course the concept of development is far older than Darwin. Theologians and historians discovered very quickly that the biologists were proclaiming a truth which, in other connexions, they had necessarily recognised; and the conflict between religion and science which in the middle of the last century agitated Great Britain has, so far as the issue of evolution is concerned, completely died away. Literalist theories of Biblical interpretation and irrational beliefs as to ecclesiastical authority do from time to time occasion friction between religious people and men of science, but such theories and beliefs are evidently losing their hold on the minds of thoughtful Christians, and now move more annoyance than reverence in the general mind.

Freedom of thought is the condition of sincere religion. Freedom of research and teaching is the first principle of academic life. It is incredible that such freedom should be prohibited in American universities. The accounts of Fundamentalism which come to us across the Atlantic indicate nothing more respectable than the injustice and absurdity of religious panic, such as was familiar enough in England at the time of the controversies occasioned by "Essays and Reviews." Mr. Bryan's pronouncements belong to the pre-scientific age, both in temper and substance. They are not creditable to the United States, and will be remembered as the vehement protests of a bigotry which is equally self-confident and obsolescent. They can have no permanent effect on American thought and life.

Rev. R. J. CAMPBELL, D.D.,
Holy Trinity Church, Brighton.

THAT a ban should be placed upon the teaching of evolution in publicly supported educational institutions in the United States or elsewhere is a puzzling fact. Probably it is in some degree the outcome of what is called the "Fundamentalist" controversy in religious circles in America, a controversy which has had few repercussions over here and is not likely to have many in the future. That such crises should be possible is evidence of what competent observers have long known, that American mentality, taken on the whole, differs considerably from that of Great Britain. I do not mean that it is necessarily inferior; in fact we know it is not; in some ways it is fresher, more alert, more productive, and there are certain fields of research and enterprise in which the American intellect leads the world.

Nor need we assume that the attitude taken by the authorities who exclude the teaching of evolution from the educational curriculum is wholly obscurantist. It is not. There is no country in the world wherein a generous idealism is more earnestly cherished than in the United States, nor, appearances notwithstanding, one wherein a soul-deadening materialism meets with more energetic protest. Probably, therefore, it is less the teaching of evolution than its supposed materialistic implications that an influential section of public opinion disapproves of; and this is not a bad sign.

All the same, it is an impossible position to take up. Neither religion nor morals can be safeguarded by proscribing free inquiry in any department of human interest. It is sure to defeat itself and to produce the opposite of what is intended. There can only be one issue to the present conflict of opinion. The assured results of modern science must and will become accessible to civilised mankind everywhere.

Prof. J. W. GREGORY, D.Sc., F.R.S.,
Professor of Geology, University of Glasgow.

THE struggle in the United States over the teaching of evolution is the newest form of the age-long contest for freedom of scientific opinion. It is a warning of the dangers of elementary education becoming a State monopoly. Whether the American Constitution can be interpreted to declare the proscription of Darwinism in State schools illegal seems to be doubtful. The only relative clause appears to be an addition to the first Article of the Constitution; that addition enacted that there should be "no establishment of religion or prohibition of the free exercise thereof" and there should be no "abridging the freedom of speech." Freedom of speech in the schools is as important in the intellectual development of a nation as is the freedom of public discussion of political issues.

Evolution is now essential to the understanding of science and of natural and moral philosophy, and the prohibition of its teaching in the schools would be as fatal to sound education as would be the prohibition of the multiplication table and the axioms of geometry to the study of mathematics. In any State wherever education is compulsory, interference in teaching is a most serious abridgment of freedom of speech. Such a State has no moral right to compel its public school teachers to teach what they regard as error or to adopt a system which renders satisfactory education impossible. Hence the Article in the Constitution that guarantees the United States "no abridging of freedom of speech" may justly be applied to public school teaching and to the prevention of exclusion from the schools of the essential foundations of education.

Rev. J. O. F. MURRAY, D.D.,
Master of Selwyn College, Cambridge.

THE object of those who are promoting the prosecution of Mr. J. T. Scopes is to safeguard faith in the divine inspiration of holy scripture. Sympathising with their object, I would plead with them most earnestly to consider whether the right way to attain it is to prohibit the teaching of any conclusions that seem at first sight inconsistent with it.

If we believe that "by the word of the Lord were the heavens made," must we not believe that patient study of the stars will help us to think God's thoughts after Him? Ought we not to listen to what He is saying to us through the works of His hands? May we not hope to attain thereby to a clearer understanding of what He is saying to us through the written word? Dare we forbid any astronomer to make any suggestion as to the constitution of the universe unless he can make it fit with what we regard as the plain meaning of particular texts of holy scripture? In so doing is it really the infallibility of holy scripture that we are trying to maintain or the infallibility of our interpretation?

The method has, no doubt, been tried. The Roman Inquisition tried it with Galileo. Is that an encouraging precedent?

R. R. MARETT, D.Sc.,
Fellow, Tutor, and Dean of Exeter College, Oxford.

I AM sure that, without help from me, the citizens of the United States are quite capable of suppressing their own obscurantists. Theirs is not the country to go back on the principle of the freedom of thought. Hence I would excuse myself from testifying to the doctrine of organic evolution, and incidentally from having to consider which particular version of it I am prepared to support at the present moment. Rather I would remind my scientific brethren over the water, lest they take the matter too seriously, and hold themselves to be shamed in the face of the world, that there are plenty of worthy folk over here just as narrow in their outlook. I have myself been invited to lecture on anthropology to a denominational congress—held, I am glad to say, not in the British Isles but in a neighbouring country—on condition that nothing should be said about evolution. For the rest, I have had to do at Oxford with Rhodes scholars coming from the obscurantist States, and have found them apparently as well educated as the rest; whence it is perhaps to be inferred that the rising generation will not limit the circuit of their musings to suit the antiquated prejudices of their elders.

Obituary.

PROF. B. GRASSI.

THE death of Prof. B. Grassi, at Rome, on May 4, robs zoology of an ardent devotee and Italy of her most famous zoologist.

Giovanni Battista Grassi was born at Rovellasca (Province of Como, in Northern Italy) on March 27, 1854. He received his early education at a private school, and then entered the University of Pavia as a medical student. But after qualifying in medicine he threw himself whole-heartedly, for the rest of his seventy-one years of life, into the study of zoology—a subject for which he had evinced, even at an early age, a singular aptitude. (He always called himself—and posterity will endorse his definition—*zoologo*, and not *medico*.) He studied first at Messina (with Kleinenberg) and afterwards in Germany—at Heidelberg (with Bütschli and Gegenbaur) and at Würzburg (with Semper). In 1883 he was appointed professor of zoology in the University of Catania (Sicily), where he remained until 1895, when he was promoted to the chair of comparative anatomy in the University of Rome. In 1897 he was elected a national fellow of the Royal Society of Italy (R. Accademia dei Lincei), and in 1908 he was made a Senator of the Realm: until the day of his death he was—scientifically—one of the most productive members of the University, the Academy, and the Senate. Our own Royal Society bestowed the Darwin Medal upon him in 1896, but never elected him a foreign member.

Grassi's contributions to zoology are so many, so varied, and so great, that they cannot be adequately reviewed in a few words. He began his researches while still a student, and continued them unremittingly until the end of his life—despite his multifarious cares of office. (He could boast, but a year ago, that he had always given more lectures every year than the University required, and had never once missed a sitting of the Senate.) Though a man of apparently feeble physique, and handicapped from childhood by defective eyesight, he was possessed of immense energy and ardour: and he never spared himself. He used to say that mankind is composed of those who work, those who pretend to work, and those who do neither; and there can be no doubt that he himself belonged to the first class. An accomplished field naturalist, with expert morphological and systematic knowledge of many groups of animals, he was also an accurate and original observer and an indefatigable experimenter—and one, moreover, who was always master of the literature of his subject. Consequently, his best works already rank among the zoological classics.

Many of Grassi's outstanding researches were done in collaboration with pupils and colleagues, among whom may be particularly mentioned Bastianelli, Bignami, Calandruccio, Feletti, Anna Foà, Noè, Rovelli, Sandias, and Topi. Since many of the problems which he successfully attacked—either alone or with the help of others—are not only of great zoological, but also of great medical and economic importance, and therefore bound up with various vested interests, it is scarcely surprising that his own restless research and unquenchable thirst for knowledge sometimes brought him into sharp conflict with opponents and rivals, and occasionally even with his fellow-workers: and unhappily the controversies aroused by some of his investigations have gained wide publicity, and have even tended in certain quarters—to obscure the indisputably great merits of these investigations themselves. He recently remarked, publicly, that he "would have led a tranquil life if he had not engaged in the study of malaria and other burning questions which have a practical application." This is pathetically true, though one may be permitted to question it.

Of Grassi's works there is space to mention only some of the greatest. His earliest studies of the life-histories of intestinal worms and protozoa—begun in 1876 and continued for some dozen years—are familiar to all specialists, and contain many important observations and discoveries. He gave, for example, the first accurate account of Giardia (Lamblia), and was the first to ascertain (partly by experiment upon himself) the method by which *Entamœba coli* and *Ascaris lumbricoides* are transmitted from man to man; and he was also the first to show that the cestode Hymenolepis completes its development without passing through an intermediate host. Curiously enough, it is only within recent years that these and others of his early observations have been verified and finally accepted.

In 1883 Grassi published his classical Naples Monograph on the Chætognatha, a peculiar group of marine animals: and ten years later (1893) he published (with

Sandias) his famous observations on "The Constitution and Development of the Society of Termites"—one of the finest entomological works ever written. In the course of this work he was led to make a detailed study of the peculiar protozoa with which many termites are infested; and these studies—begun in 1885, and ending with his extensive and beautifully illustrated memoir of 1917—are scarcely less important than those which he has published on the termites themselves.

In 1887 he began (with Calandruccio) a very different investigation which ultimately yielded results no less remarkable—his study of the life-history of the eels. The development of the eel is a problem which had puzzled biologists from the time of Aristotle; but in 1896 Grassi was able to announce that he had solved it, in its general terms, though full details of his work were not made known until 1913, when his magnificent monograph on "The Metamorphosis of the Murænoids" appeared.

From about 1890 until 1892 Grassi was also occupied (with Feletti) in studying the malarial parasites. In 1898 he returned to this subject with renewed energy, and succeeded in 1898 and 1899—with the collaboration of Bignami and Bastianelli—in solving once for all the problem of the mode of transmission of human malaria. He was then able to demonstrate that certain mosquitoes (Anopheles), and these mosquitoes only, convey malaria from man to man; and he worked out, for the first time, the entire life-history of the human malarial parasites in these insects. The importance of these discoveries needs neither emphasis nor advertisement. His great monograph—"Studies of a Zoologist on Malaria"—was published in 1900. It is still unsurpassed, and is universally acknowledged by protozoologists as one of the classics of their science.

About 1905 Grassi turned his attention to another organism of vast economic importance—Phylloxera, an insect which has done incalculable damage to the vineyards of Europe since its accidental introduction from America some sixty years ago. With various collaborators (Foà, Topi, and others) he continued to labour at the biology and control of this insect until the end of his life. His most important publication on the subject—issued by the Italian Ministry of Agriculture in 1912—has recently been described by a distinguished entomologist as "a milestone in the history of entomology."

Another important entomological work by Grassi is his memoir on the sand-fly (Phlebotomus). In this he gave (1907) the first good account of the structure and life-history of an insect which has recently attracted much medical notice, owing to the part which it appears to play in the dissemination of more than one human disease. During the last few years of his life Grassi returned again to the study of malaria and its prevention, and published—among other works—a series of most interesting papers on the biology of mosquitoes.

These are some of the works for which the name of Battista Grassi will ever remain famous in zoology—both pure and applied—and in medicine. Severally his contributions to helminthology, to entomology, to protozoology, or to ichthyology, would be sufficient to establish the reputation of a lesser man in any one of these sciences: taken together, as the work of a single individual and his assistants, they constitute a record of achievement almost unparalleled in the history of zoology.

CLIFFORD DOBELL.

WE regret to announce the following deaths:

Commendatore Giacomo Boni, director of the excavations in the Forum, Rome, and on the Palatine, where he made important archæological discoveries in the Temple of Vesta and on the site of Domitian's Palace, respectively, on July 7, aged sixty-six years.

Dr. Charles Forbes Harford, a founder and the first Principal of Livingstone College, Leyton, on July 4, aged sixty years.

Dr. Felix Klein, For. Mem. R.S. and Copley medallist of the Society, professor of mathematics in the University of Göttingen, who has added to our knowledge of non-Euclidean and carried out researches in the theory of functions, on June 22, aged seventy-six years.

Current Topics and Events.

IN 1915 a new chapter was opened up in the cancer mystery by the discovery of Yamagiwa and Ichikawa that cancer can be successfully induced in rabbits by the prolonged application of gas works' tar. This result was soon confirmed, and during the last ten years a large number of tumours have been produced in mice, rabbits, and even in fowls. In addition to cancer in the strict sense, other malignant tumours have developed as a result of the application of tar products. There is no longer any doubt that the induced tumours are true blastomata. They possess every attribute which has been associated with the idea of malignancy. Tar is, of course, not the only chemical irritant which produces tumours, but it is the one that most readily does so under experimental conditions. It is also known that different tars vary greatly in their cancerogenic properties. The actual agent in the tar has been sought, and although not yet completely identified, a large body of knowledge has already grown up on the subject. Apparently the acids and bases of tar can be removed while the cancerogenic agent remains.

A SHORT time ago, E. L. Kennaway, of the Cancer Hospital Research Institute, London, obtained results which pointed to the conclusion that isoprene compounds prepared at about 820° C. are more active than the original coal tar from which they are obtained. In a more recent paper (*Brit. Med. Journ.*, 1925, ii. p. 1, July 4) Kennaway has made a further important contribution to the cancerogenic properties of "tars," by showing that acetylene heated to 800°-900° C. is capable of producing tumours. A Californian petroleum, in itself apparently incapable of producing cancer, became so when heated to 800° C. in a current of hydrogen. More extraordinary still, he found that human skin or yeast dried and heated to 920° C. produced malignant tumours in mice. Although these products, up to the present, can only be produced at

high temperatures, "it is possible," as Dr. Kennaway says, "that the body at its own temperature takes months or years to produce a quantity of some substance sufficient to influence the growth of a few cells only"; whether this is so or not, it seems probable that we are getting definitely nearer the solution of the cancer problem.

YET another step in the progress of our knowledge of cancer is promised in the announcements which have appeared of a paper by Dr. W. E. Gye, to appear in the *Lancet* of July 18. At the time of writing no details are available, but it would seem that Dr. Gye, who has been supported by the Medical Research Council and assisted by Mr. J. E. Barnard and Dr. J. A. Murray, the latter of the Imperial Cancer Research Fund, has discovered a filter-passing organism in cancers of birds, rodents, and other mammals, including man. The organism itself, however, does not give rise to cancer when injected into healthy animals; it requires the presence of a so-called specific factor obtained by injecting a tumour extract from the species of animal which is being used for experiment. In the presence of extract of a sarcomatous tumour freed from the newly discovered organism, the organism itself, whatever its source, is able to cause sarcomatous growth in an animal of the species from which the extract has been made. Extracts of carcinomatous growths would appear to be ineffective. Mr. Barnard's work on the use of uitra-violet light and other short-wave radiation for photographing, under the microscope, objects of very minute size, is well known, and his share in the present work has apparently been concerned with photographing the organism. If the discovery is fully substantiated, it should mark an important advance in medical knowledge.

ON Monday, July 13, the King, who was accompanied by the Queen, opened the new house of the British Medical Association, Tavistock Square, London, in the presence of an assembly of medical representatives from the Dominions and Colonies, from many organisations in Great Britain, and from the continental countries of Europe, and a special delegation from the American Medical Association. Shortly before the arrival of the King and Queen, the memorial gates at the entrance of the courtyard of the building were dedicated by the Archbishop of Canterbury to the memory of the 574 members of the Association who lost their lives in the War. The King and Queen were attended by Mr. Neville Chamberlain, Minister of Health, and proceeded to the Great Hall of the new building, where the chairman of the Council of the Association, Dr. R. A. Bolam, read an address outlining the origin and aims of the British Medical Association. Throughout its existence, the Association has striven to maintain the traditions of the medical profession and to keep its members alive to the advance of the science and art of medicine. Medical men, he said, have a duty not only to their patients but also to the community in the protection of public health. Reference was also made to the fact that there are now no less than 2250 women members of the Association. In his reply, the King remarked on the great increase in membership and usefulness of the Association since its foundation in 1832. The importance of qualifying examinations and prescribed training as a preliminary to admission to the Medical Register was emphasised, with the warning that "vigilance must always be exercised in order that your profession may keep abreast with the advance of science." In this connexion reference was made to the value of post-graduate study. Passing on to the relation of the medical practitioner to public health, the King said that the welfare of the peoples of the British Empire "depends largely upon an efficient and well-organised health administration," and referred to the medical practitioner as a "missionary and teacher of public hygiene and of personal health"

ON Thursday, July 9, the Sargant Laboratory of Plant Physiology at Bedford College for Women, London, was opened by Lord Justice Sargant. The Principal, in introducing Lord Justice Sargant, spoke of the sympathetic interest Miss Alice Sargant had shown towards Bedford College and of the important share she took in furthering the acquirement of the present unique site in Regent's Park. Upon her death Miss Sargant had bequeathed a sum of 1000*l*. for the furnishing of a library and herbarium in the Botany Department and for the erection of a physiological greenhouse. The War intervened before the latter project was carried out and post-War conditions rendered the unexpended balance inadequate for the purpose intended. Recently, however, as the result of a legacy, the Council of the College has been able to provide a sufficient additional sum to permit the erection of a small laboratory and experimental greenhouse.

IN declaring the new Sargant Laboratory of Plant Physiology open, Lord Justice Sargant acknowledged the kindly thought that had connected his sister's family name with the laboratory. He pointed out that Alice Sargant's contact with botany was artistic and literary rather than scientific, and that in his own mind he would always associate with the building the memory also of his other sister, Ethel Sargant, who took a keen interest and an active part in scientific botany. A vote of thanks was moved by the chairman of Council, Sir Wilmot Herringham, and seconded by the head of the Botany Department, Prof. W. Neilson Jones, after which the new laboratory was inspected. Among the exhibits were a collection of portraits of botanists and others after whom plant genera had been named, together with specimens of the plants concerned, demonstrations of researches carried out by various members of the Department of Botany, apparatus for the study of plant physiology, and a number of interesting plants. The Botany Department of Bedford College is fortunate in possessing a small but well-stocked botany garden, inspection of which provided an attractive item in the entertainment of those who attended the ceremony on July 9. The position of the new laboratory in close proximity to the garden ensures a supply of suitable plant material for work in plant physiology.

AN influential and representative deputation waited on Mr. L. C. M. S. Amery, Colonial Secretary, at the Colonial Office on July 7 to urge the claims of the Imperial College of Tropical Agriculture to continued Government assistance on an extended scale. It comprised several members of Parliament of both Houses, eminent men of science, and representatives of the principal organisations associated with the Dominions and Colonies in Great Britain. Lord Burnham, who introduced the deputation, read a letter from Mr. Ramsay MacDonald expressing interest in the movement and his hopes for its success. Sir Arthur Shipley then briefly reviewed the history of the College, and, referring to the financial position, pointed out that funds were urgently needed to enable the Governing Body to proceed with the erection of hostels and the provision of an estate. Thus the College might be placed in a position to provide for the requirements of the students, who would be proceeding to it under the scheme prepared by the Committee of which Lord Milner has been chairman, for the training of officers for the Agricultural Departments throughout the Empire. The cost of the hostel he placed at 25,000*l.* and that of the estate for research work and the practical study of farming in all its branches at 25,000*l.* Mr. Amery in reply stated that the case of the College has already been before the Committee of Civil Research, and that he hopes now to take the matter up more definitely and directly with the Chancellor of the Exchequer with the view of seeing what financial support is possible. He has, he said, the greatest faith in the future of the College, which he believes will develop into an Imperial University of Tropical Agriculture.

A MEMORANDUM regarding the probable amount of monsoon rainfall in 1925 was issued early in June by Mr. J. H. Field, Director-General of Observatories of the Meteorological Department to the Government of India. The rainfall of India is affected by previous weather conditions over various parts of the earth. For the Peninsula the indications from Java, the Cape, South America and Dutch Harbour are slightly unfavourable this year, but their combined effect on monsoon prospects is small. For north-west India a prejudicial influence exists this year from the very large excess of rainfall in south Rhodesia, and this receives some little support from conditions at Dutch Harbour; the effect of the other factors is negligible. For the Bay monsoon current the only indications as yet discovered are those from the wind and rainfall of Seychelles; the rain has been normal, but the strength of the wind is a favourable feature. Monsoon rainfall would appear to be likely to be normal or in defect in the Peninsula, normal or in excess in north-east India, and in defect in north-west India.

SIR RICHARD REDMAYNE, formerly chairman of the Imperial Mineral Resources Bureau, which has recently been amalgamated with the Imperial Institute, South Kensington, has been appointed director of the Imperial Institute. He has accepted the appointment on the understanding that it will be for a short period only, in order that he may supervise the amalgamation of the two bodies.

AT the ordinary meeting of the Royal Society of Edinburgh held on July 6, the Makdougall Brisbane Prize for the period 1922–1924 was presented by the president to Prof. H. Stanley Allen, professor of natural philosophy in the University of St. Andrews, for his investigations in theoretical physics, particularly for his communication to this Society on the magnetic character of the quantum, and on static molecular models of hydrogen and helium.

THE Chalmers Memorial Gold Medal was presented at the recent annual general meeting of the Royal Society of Tropical Medicine to Prof. Warrington Yorke, professor of parasitology in the University of Liverpool and Liverpool School of Tropical Medicine, in recognition of his work on trypanosomiasis, malaria, and other subjects. The medal is awarded biennially to persons less than forty-five years of age for "researches of outstanding merit contributing to our knowledge of tropical medicine and hygiene."

M. A. F. DINA and his wife have given the Paris Academy of Sciences a sum of a million francs, the income from which is to be devoted to the manufacture or purchase of astronomical instruments for observatories concerned with astronomy, meteorology, or geophysics, together with an astronomical library for such observatories.

PROF. W. M. DAVIS, emeritus professor of geology at Harvard University, and Dr. G. Holm, Geological Survey of Sweden, Stockholm, have been elected foreign members of the Geological Society. Prof. P. Lemoine, professor of geology in the National Museum of Natural History, Paris; Dr. V. Madsen, of the Royal Library, Copenhagen; Prof. P. Niggli, professor of mineralogy and petrography in the University of Zürich; Prof. J. F. Pompeckj, professor of geology in the University of Berlin; Dr. T. W. Vaughan, of the United States Geological Survey; and Dr. M. D. Zalessky, Leningrad, have been elected foreign correspondents.

THE Summer Meeting of the Royal Cornwall Polytechnic Society will be held on July 21-24 at the Polytechnic Hall, Falmouth. An exhibition of Cornwall art and handicraft will be opened on July 21 by the president, the Right Hon. Viscount Falmouth, who will give an address on "Recent Developments of Physical Science," which will be followed by a paper by Mr. Henry Jenner on "The Holy Wells of Cornwall." Other papers to be read during the meeting are: "Boulton and Watt in Cornwall," A. K. Hamilton-Jenkin, and "The Mining Coinage of Cornwall," E. W. Newton. On Friday, July 24, a lecture will be given by Dr. W. D. Prendergast on Cornwall and the ceramic industry.

A MEDAL for archæological research has been instituted, and attached to the Board of Archæology in the University of London. The first presentation was made at University College, on July 7, by Prince Arthur of Connaught, to Sir Flinders Petrie in recognition of his half-century of work for archæology. The medal bears Sir Flinders Petrie's bust on one side, and on the other the searching ibis, the hieroglyph of

"finding," placed before the head of Khufu, which was found by Sir Flinders. In returning thanks for the presentation Sir Flinders compared the expansion of the knowledge of man by the methods of archæology, to the extension of our knowledge of the universe by spectrum analysis, two movements which had grown simultaneously within his memory.

THE following are among the Civil List pensions recently granted:—Miss Maria Birch, in recognition of the services rendered by her father, the late Dr. Walter de Gray Birch, to the science of archæology, 100*l.*; Mr. J. T. Cunningham, in recognition of his services to zoological science and economic zoology, 100*l.*; Prof. Patrick Geddes, in recognition of his public and educational services, 100*l.*; Mrs. Amelia Sarah McLeod, in recognition of the services rendered by her husband, the late Prof. Herbert McLeod, F.R.S., to science, 45*l.*; Mrs. Emily Rambaut, in recognition of the services rendered by her husband, the late Dr. A. A. Rambaut, to astronomical science, 50*l.*

FOLLOWING a highly successful conference held at High Leigh, Hoddesdon, in September 1924, of those interested in special libraries and agencies for the collection, treatment and distribution of information, a representative standing committee was appointed to ensure continuity of the work. Assistance has been obtained from the Carnegie United Kingdom Trustees, and the proceedings of the first conference have just been issued. The committee has decided to name the body thus called into being "The Association of Special Libraries and Information Bureaux." The second conference of the Association will be held at Balliol College, Oxford, during the week-end September 25-28; full particulars can be obtained from the Organising Secretary at the Offices of the Association, 38 Bloomsbury Square, London, W.C.1.

Observation, of which we have recently received Part 3, is a periodical intended for readers of secondary school and training college age. It is issued by Leplay House, London, and as might, therefore, be expected, its keynote is the cultivation of the faculties of observation in everyday life. Its articles record the results of first-hand observations of peoples, activities, and places. Those in the present number deal, among other matters, with Sarawak, this by Mrs. Charles Hose, the Scillies and their bird life, London and its buildings, place names, wild flowers, and typical Norwegian farms. The articles are well illustrated.

WE have received from the Mellon Institute of Industrial Research of the University of Pittsburgh the list of publications and patents by members of the Institute during 1925. This gives evidence that the wide variety and practical utility of the subjects investigated in the Institute still continues. Laundry work, refrigeration, fire-extinction, smoke-abatement, and the design of ventilators are a few of the subjects of publications or patents. The subject "Jewelry from Fish Scales" recalls the famous experiment for extracting sunshine from cucumbers, to which the discovery of vitamins has given a new meaning. It is evident from the list that industrial research as understood at the Mellon Institute embraces all the experimental sciences.

THE April issue of the Journal of the Franklin Institute contains two interesting papers, one, by Prof. Haber, on the practical results of the theoretical development of chemistry, and the other, by Prof. Donnan on the influence of J. Willard Gibbs on the science of physical chemistry. Dr. Haber commences with a consideration of the "structural" period in chemistry, a period in which dyestuff investigation was developed. This was followed by the "thermodynamic" period. The application of thermodynamics to solution phenomena and the advent of the electrolytic dissociation theory fall within this period. In this connexion nitrogen fixation and the use of catalysts in general are discussed. The third period is that through which we are now passing, namely, one in which atomic structure is being interpreted electrically. Capillary chemistry falls in this class and the theories of adsorption are described in detail, simple explanations being given for Szyszkowski's empirical law and for Freundlich's adsorption isotherm. Prof. Donnan's lecture shows how firmly Gibbs laid down the foundations of thermodynamics, and an excellent account of Gibbs's method is given. The phase rule is given prominence, and Prof. Donnan shows throughout how much indebted are modern workers in this field to the fundamental researches of the great American physicist.

WE have received from Messrs. Adam Hilger, Ltd., a pamphlet entitled "Applications of X-Ray Spectrography and Crystallography to Metallurgy and to Chemical Problems," supplementary to the small volume on optical methods in research issued by the same firm. The pamphlet contains useful hints on the methods and limitations of X-ray spectroscopy, followed by suggestions as to the use of this method for the solution of practical problems in metallurgy. In illustration, examples are quoted from recent authors, showing how the deformation of crystalline aggregates as well as of single crystals produces characteristic changes in the X-ray pattern given by a metal, as in the work of Taylor and Elam, Polanyi, Bain, and others. An excellent bibliography is appended, from which, however, we miss any reference to the work published in *Stahl und Eisen* or in the *Mitteilungen der Institut fur Eisenforschung*. Work of this kind has, among other things, shown the remarkable similarity between the structure of natural fibres, such as cotton and silk, and that of cold-drawn metallic wires. The mechanism of deformation of crystals is still a matter for controversy, and it seems probable that some refinement of X-ray technique will be necessary before this method can be expected to give results quite free from ambiguity. The evidence already available is, however, of the highest interest, and no metallurgist who is interested in the problem can afford to disregard it.

A SHORT but useful catalogue of second-hand science books has reached us from Messrs. W. and G. Foyle.

Ltd., 121 Charing Cross Road, W.C.2. It gives particulars of nearly four hundred works dealing with zoology in general, with separate sections relating to ornithology, entomology, and botany. The list is sent free upon request.

MESSRS. Dulau and Co., Ltd., 34 Margaret Street, W.1, have recently issued two useful catalogues (Nos. 129 and 130). No. 129 contains some 1300 books and papers on entomology, conveniently classified under the names of the insect orders, economic and general entomology, serial publications, and Arachnida. In No. 130 are listed upwards of 2000 works classified under the headings of ornithology, mammals and sport, reptilia, fish and fishing industries, conchology, general zoology, biology, Darwinism, evolution, heredity and Mendelism. The catalogues can be obtained free upon application to the publishers.

WE have received the annual booklet issued by Messrs. Burroughs Wellcome and Co., which gives instructions and formulæ for photographing with the aid of their tabloids and Photographic Exposure Calculator. It includes the technique of desensitising, and a page of plate speeds which brings the speed tables in the Exposure Calculator up-to-date. The booklet, "Photographic Signposts," is sent post free on application to Messrs. Burroughs Wellcome and Co., Snow Hill Buildings, London, E.C.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: A full-time teacher for mining courses under the County Council of the West Riding of Yorkshire—The Technical Branch, County Hall, Wakefield (July 23). An assistant master to organise biological teaching in Campbell College, Belfast—The Headmaster (July 25). An assistant lecturer in mathematics in the University of Manchester—The Internal Registrar (July 31). A junior demonstrator of anatomy in the University of Birmingham—The Secretary (July 27). An assistant lecturer in engineering in the University of Manchester—The Internal Registrar (August 1). A demonstrator in physics in the University of Leeds—The Registrar (August 6). Lecturer in physiology in the University of Birmingham—The Secretary (August 24). The Dutton Memorial professorship of entomology in the University of Liverpool—The Registrar (October 1). The Ormond professorship of music in the University of Melbourne; the senior lectureship in philosophy in the University of Melbourne—The Agent-General for Victoria, Australia, Melbourne Place, Strand, W.C.2 (October 15). A full-time lecturer in mathematics at University College, Southampton—The Registrar. Lecturer on tropical hygiene at the London School of Hygiene and Tropical Medicine—The Secretary, 23 Endsleigh Gardens, N.W.1. A demonstrator in physics in the University of Toronto—Prof. J. C. McLennan, Athenæum Club, Pall Mall, S.W.1. Senior physics master at the Cowley Boys' School, St. Helens—Secretary for Education, Education Office, St. Helens.

ERRATUM.—In the issue of July 4, p. 22, col. 2, line 22, for "South American" read "South Italian."

Our Astronomical Column.

THE DELPORTE OBJECT.—M. Delporte has issued a notice of erratum in his telegram announcing the finding of this object. The figures $+1^m\,48^s$, N. 14′ were really the motions in R.A. and Decl. in 2 days, not 1 day. Making this alteration, it was soon found that the object is not new, but is identical with the minor planet 29 Amphitrite, which is in opposition next October, some six months before its perihelion. It had already been perceived that Amphitrite was close to the position given by M. Delporte, but the original statement of its motion seemed fatal to identity.

Amphitrite is one of the brighter members of the family, and was discovered by Mr. A. Marth in London in 1854.

THE NEAR APPROACH OF EROS IN 1931.—Dr. G. Witt, who discovered Eros in 1898, has been studying its perturbations for many years, and gives in *Astr. Nach.*, 5375, an ephemeris from October 1, 1930 (parallax 12·2″), to May 5, 1931 (parallax 16·4″). It is nearest to the earth (parallax 50·3″) on January 30, fifteen days after perihelion. Its magnitude will then be 7·1, so that it will be easily visible in a field-glass.

The declination is $+44°$ on October 1, $-3°$ on January 30, $-22°$ on May 5.

The same issue of the *Astr. Nach.* contains a list of stars for comparison with Eros. Very few of them are fainter than 9·0 mag., so observations with meridian instruments are desired. Each plate of $2° \times 2°$ will contain about eight of these stars. Fainter stars will be necessary for instruments with long focus, but their places can be photographically determined, using the stars of this list as a basis. The present list contains 419 stars and follows the place of Eros for October 1 to January 8. A second list will be issued for the remainder of the apparition.

CARBON BANDS IN COMET TAILS.—M. F. Baldet has studied the effect of pressure on the band spectrum of carbon in a thermoelectronic tube (*C.R. Acad. Sci.*, Paris, April 20). He finds that at low pressures the second and third positive groups of bands and the new group recently discovered by him disappear, leaving only the third negative group, or comet tail spectrum, and the first negative (ultra-violet) group, which remain well developed. Under these conditions the emission of light is due to electronic shocks, while at higher pressures the shocks of ionised molecules with one another and with neutral atoms are concerned, giving the other band systems mentioned above. This seems to confirm Deslandres' theory of corpuscular or electronic radiation from the sun, which produces the coronal streamers and the polar aurora. So far only the negative group of nitrogen in the comet Morehouse has been ascribed to the action of this electronic radiation; but from the work of M. Baldet and others it now appears probable that the carbon bands observed in comet tails are due to the electronic bombardment of oxides of carbon at exceedingly low pressure.

Research Items.

ARCHAIC SCULPTURE, GORGONA ISLAND, SOUTH AMERICA.—Mr. James Hornell, who is the official ethnologist of the *St. George* Expedition, organised by the Scientific Expeditionary Research Association, gives in *Man* for June a detailed account of the archaic sculptures which were discovered on Gorgona Island, off the coast of Colombia. These sculptures were on two groups of boulders, the majority of the older examples being below present tidal level. On many of the stones it can only be discerned that designs have existed, but on four they are comparatively well preserved. These form an ordered group around a huge, roughly quadrangular boulder bearing upon its upper surface the representations of a pair of rude ungainly human figures, male and female, each with a number of rays around the head in the shape of a halo. The figures stand side by side. The male measures 1 ft. 10 in. in height. The outlines are formed by broad, shallow, rounded grooves On another stone is a rudely sculptured stepped pyramid of four superimposed platforms, progressively decreasing in size Six circular depressions or cups occupy the face of the third storey and the upper half of the second. This pyramid may be a representation of an early form of the Mayan and Aztec temple of the sun, the six cups representing astral deities. Of the other two boulders, each has a representation of a monkey of crude and childish design. Other sculptures, belonging to another and later group, and pottery and stone implements were also found

AUSTRALIAN AND MELANESIAN AFFINITIES IN SOUTH AMERICA.—Dr. Paul Rivet, in a communication to the Académie des Sciences et Belles Lettres, which appears in the *Comptes rendus* covering the session 1924, discusses the evidence for concluding that certain of the peoples of Central and South America exhibit affinities to the Australians and Melanesians. Up to the present, all efforts to establish a connexion between the languages of America and of the Old World have failed except in the case of the Eskimo, whose language probably belongs to the Ural-Altaic group. Now, however, it appears that the Hoka group, comprising a great number of tribes, extending with some interruptions along the Pacific coast from the south of Oregon to Tehuantepec, shows marked similarities in vocabulary to the Melaneso-Polynesian languages. A second, known as the Tson group, which includes the Patagonians and the Ona, in like manner exhibits affinities with the Australian languages. It is remarkable that those resemblances are found among the rare words which are common to the highly differentiated Australian dialects. In each case the similarities are the more noteworthy because the Australian and Melanesian vocabularies, from which the material for comparison has been taken, contain a comparatively small number of words. In 1909, ten Kate and de Quatrefages both pointed out that a Californian people and the Lagoa Santa race presented affinities in osteological characters with the hypsisteno-cephalic race of Melanesia, and this has recently been confirmed by R. Verneau; while Graebner, Nordenskiold and P Schmidt have pointed to the remarkable similarities in South American and Melanesian material culture. In the case of the Australian, Verneau has pointed to the existence of a platy-brachycephalic type in Patagonia which is Australoid, and recently Lebzelter has described an Ona cranium in which this character is even more marked.

USES OF INTELLIGENCE TESTS.—The Bureau of Education, Washington, has issued a leaflet (City School Leaflet, No. 20), dealing with the uses of intelligence tests in 215 cities. A questionnaire was sent to all superintendents of schools in cities of 10,000 or more population with the request that they should indicate the various purposes for which they are using tests in the elementary, junior, and high schools. The replies show that group intelligence tests are chiefly used in the schools for the purpose of classifying the pupils into homogeneous groups and for supplementing the teachers' estimates of pupils' ability, and to a much less degree for vocational guidance. Individual intelligence tests are chiefly used for dealing with subnormal children and for classification purposes; standardised educational tests are used for supplementing the teachers' estimates of the pupils' ability and for comparison with other school systems. Among the other purposes are: diagnosis of causes of failure, promotion, vocational guidance, establishment of classes both for subnormal and supernormal children. The three tables supply some interesting and valuable information. It is surprising to find that they are utilised for vocational guidance purposes to a relatively small extent.

"WATER SHUT-OFF" IN OILFIELDS.—Mr. F. G. Rappoport read a paper on this important subject before the Institution of Petroleum Technologists on May 5, wherein he demonstrated the necessity for close co-operation between chemist, engineer, and geologist in dealing with this problem. Little more than arbitrary methods of prevention, usually confined to a particular well, used to be adopted, with the result that though the well might temporarily benefit, it ultimately formed the means whereby water gained access to upper oil-bearing sands over a large area. Experience, however, has taught the lesson; so much so that to-day in many countries not only is there co-operation between the various operators concerned, but Government regulations also exist in order to enforce those measures essential to the control of water flow throughout the oilfields, for example, in California, Burma, Rumania, and the Dutch East Indies. From a chemical point of view the differentiation of waters associated with petroleum is a specialised analytical process which has developed greatly during the past few years; such differentiation is to some extent a means of sub-surface correlation of water sands, and hence often a key to the disposition of related oil sands. Cementation, the universal panacea for all water ills, implies chemical research on the particular cement used. The mechanical means of preventing water encroachment concern the field-engineers, who are not only responsible for the process of cementation or other method employed, but also, acting in consultation with chemist and geologist, are careful to ensure that proper and systematic casing of the well is carried out for water shut-off, as much as for lining the well, as a factor in production.

ESTONIAN OIL-SHALE INDUSTRY.—The Estonian oil-shale or "kukersite," as it is known, was first discovered by Engelhardt some 135 years ago, but its exploitation on a commercial scale only dates from 1919, after the Estonian Government had taken over the original shale mine from the Germans, following their occupation of the country in 1918. There are now two mines, one at Kohtla (open cut mining), the other at Kukruse (underground system); a third mine at Vanamoisa has lately been developed by a syndicate operating with British capital. For 1923 there was an output from the State mines of 206,000

metric tons, while 13,140 metric tons were produced in the same year by private companies. Some diamond drill boring has been carried out for the purpose of testing the extent of available resources of kukersite, and the high reserve of 3800 million tons has been estimated; to this must be added the resources of unexplored areas, which brings the estimated total up to 5000 million tons. Experimental distillation of the shale on a commercial scale, using a continuous producer-retort, has resulted in a throughput of about 8 tons in twenty-four hours, the yield of crude oil amounting to 20 per cent. of the weight of the raw shale. The ultimate composition of this oil is carbon 81 26 per cent., hydrogen 10 15 per cent., oxygen 7 26 per cent., sulphur 1 08 per cent., and nitrogen 0 25 per cent. According to Mr. P. N. Kogerman, from whose paper before the Institution of Petroleum Technologists on April 23 these facts were gathered, this oil is at present used mainly as a fuel oil, little fractionation being attempted, though steam distillation at 100° C. yields a light oil suitable for motor cars, while a heavier fraction of "motor oil" for oil-engines distils over between 280-300° C. The residue is a high quality "shale asphalt." The success of this experimental work has led to the erection of a large oil distillation plant, consisting of a battery of six retorts with a 200-ton shale capacity in twenty-four hours, capable of yielding 40 tons of oil per day.

THE CAUSES OF GLACIAL PERIODS.—Geological evidence leads to the conclusion that there has been a more or less regular series of glacial periods, alternating with warmer interglacial ones, in the history of the earth, but the theories advanced to explain their causes have been inadequate. A well-known Russian meteorologist, P. J. Brounov, has recently put forward in *Priroda*, a periodical of the Russian Academy of Sciences, 1924, No. 7-12, a theory based on astronomical and meteorological data. Formation of glaciers, according to him, depends not so much on coldness of climate as on the quantities of snow falling in a certain country. The main factor causing snowfalls are the ascending currents of air which are characteristic of cyclones. There are two zones of cyclones in the northern hemisphere—the northern, where the cyclones have a N.N.E. direction and bring snowfalls, and the southern, with warm, rain-bringing cyclones. The two zones are separated from each other along the zone of barometric maximum, which runs around the globe between latitudes 33° and 35°. The latitudinal position of this zone plays a most important part in determining the climate of the two cyclone zones. Its position, however, depends to a great extent on the velocity of rotation of the earth, since this influences deviation in the direction of cyclones. There is extensive astronomical evidence that the velocity of rotation of the earth undergoes fluctuations dependent on various causes. These fluctuations must result in corresponding shiftings of the zone of barometric maximum, that is, in considerable changes of climatic conditions in the cyclone zones. Acceleration of the velocity must result in shifting the zone of barometric maximum towards the equator, and that would mean a corresponding extension southwards of the northern zone of cold cyclones with snowfalls; on the other hand, when the rotation of the earth becomes slower, the zone of maximum is shifted northwards and warmer conditions prevail in the middle latitudes. During the last glacial period, according to Prof. Brounov, the zone of barometric maximum ran in Europe, roughly speaking, along the Mediterranean Sea; after that period it shifted northwards, which resulted in a relatively dry and warm period; at present the zone is apparently shifting southwards, and Europe is threatened with a new glacial period.

A NEW PENTAMEROID BRACHIOPOD FROM ALASKA.—Mr E. Kirk has published a description of Harpidium, a new pentameroid brachiopod from the Upper Silurian of south eastern Alaska (Proc. U.S. Nat. Mus., vol. 66, art. 32). So far as at present known the genus is not represented elsewhere. It resembles Conchidium in its general proportions, and Pentamerus in being nonplicate, but Harpidium and Conchidium seem much closer genetically than either is to Pentamerus. No true Pentamerus has as yet been found in faunas of the north Pacific type, but in the interior of Alaska what appears to be a Pentamerus has been met with. The interior region of Alaska, however, has closer affinities with the Rocky Mountain geosyncline and the interior of America than it has with the true Pacific region. The more or less complete separation of Pacific and interior faunas seems to have held up to the time of the high middle Devonian, when there appears to have been fairly free communication between the two faunal regions. The author describes and figures three new species of Harpidium.

UPPER AIR IN EGYPT AND THE SUDAN.—The Ministry of Public Works, Egypt, has issued a Physical Department Paper, No. 17, on "The Upper Currents of the Atmosphere in Egypt and the Sudan" by Mr. L. J. Sutton, Director of the Meteorological Service. Pilot balloon observations were commenced at the Observatory of Helwân, 25 kilometres south of Cairo, in 1907, and daily ascents have been made except on Fridays, during the four years 1920–1923. Other observations were made at Wadi Halfa, Khartoum, Mongala, and Roseires on the Blue Nile. The object of the paper is not only to find mean values of the wind velocity and direction at various heights but also, when possible, to associate these values with recognised types of pressure distribution at the surface, thus a study of the daily weather map will provide better assistance in anticipating the upper winds than can be obtained from mean values calculated without respect to the surface pressure. Eleven different types of weather in Egypt are considered, and the accompanying pressure and winds are illustrated by the several maps covering the surrounding neighbourhood for each. The frequency of occurrence for each type is given for the several months and for the year. The discussion will without doubt prove very helpful for aviation, and much valuable information is given of the upper air changes for the several stations and for the different types of weather.

A STUDENT'S THEODOLITE.—The teaching of practical surveying is often hampered by the fact that the number of instruments available for instructional purposes is small in relation to the number of students in the class. The cost of the apparatus is usually the cause of the scarcity. A Student's Theodolite, which has recently been placed on the market by Messrs. C. F. Casella and Co., Ltd., 49 Parliament Street, London, S.W. 1, should help to overcome this difficulty. The tribrach, upper horizontal plates and standards are made of seasoned mahogany. The circles are of hard white celluloid, 6 inches in diameter, and engine machined to 1°. The telescope, which gives a magnification of about 4 diameters, has a fixed diaphragm, and both object-glass and eye-piece can be focussed. A graduated bubble and a trough compass are provided, and the instrument is mounted on a twofold tripod. The accuracy obtainable is not of the same order as that of a professional model, but the instrument reproduces all the essential features of a standard

transit theodolite. The outfit should prove of service not only in assisting students to obtain an acquaintance with the broad principles of survey work, but also in preparing them to use instruments with vernier or micrometer scales and other fine adjustments.

THE SPECTROSCOPIC DETECTION OF ISOTOPES.—In line spectra, due to electronic jumps in the atoms, the effect of isotopes is exceedingly minute, since the energy changes are governed by the amount of the nuclear charge, and the mass of the nucleus is of very little importance in determining the frequency of the emitted light. In a paper in the March issue of the *Physical Review*, Dr. R. S. Mulliken gives the results of an investigation of the band spectrum of boron monoxide, having shown in a previous paper that, in the case of a compound, one of the elements of which consists of two isotopes, two similar superposed band systems are to be expected, on somewhat different scales, and with intensities proportional to the relative amounts of the two isotopes in the element. The band spectra are due in part to electronic jumps, but also very largely to vibrations and rotations of the molecule, in which the masses of the nuclei are of importance, and the isotopic effects are considerable. Two such band systems exist in the spectrum of boron monoxide, the weaker and larger scale system being apparently due to the less abundant isotope, B^{10}, and the other to B^{11}. At certain positions in the spectrum, differences of more than 40 Å.U. were observed between the wave-lengths of corresponding band heads. The measurements agree in a remarkable manner with the theory.

MEAN FREE PATH OF NEUTRAL SILVER ATOMS IN NITROGEN.—Dr. F. Bielz describes, in the *Zeitschrift fur Physik*, April 28, a series of measurements made with an apparatus similar to that previously employed by Prof. Born and Fraulein Borman. A stream of silver atoms passed from a chamber, which was heated in an electric oven, through a narrow tube, into a space containing cool nitrogen at a low pressure, forming a narrow "beam." Three small glass plates at different distances from the entrance tube could be shifted in turn into the path of the beam by means of a magnetic arrangement, the times of exposure of the three plates being nearly equal. The thin layers of silver deposited were treated with iodine vapour to convert them into silver iodide, and their thicknesses, which varied with the distance from the entrance tube, were measured, using an Abbe microspectroscope and the Wiener interference method. The mean free path of the silver atoms was then calculated by means of a formula derived by the author, and it was found that the product of pressure and mean free path was constant, within the limits of experimental error, for pressures of 1 to 7×10^{-3} mm. Hg. The radius of the neutral silver atom calculated from this product is 1.0 Å.U.; values ranging from 0.57 Å.U. to 1.78 Å.U. have been found by other observers using other methods. Dr. Bielz states that no source of error occurs in his experiments which would make his value too low.

OPTICAL PHENOMENA AND THE QUANTUM THEORY.—In the April number of the *Physical Review*, Dr. J. C. Slater puts forward a detailed theory of optical phenomena, based on suggestions already made by him in conjunction with Bohr and Kramers (*Phil. Mag.*, vol. 47, p. 785). The atoms are supposed to radiate and absorb during the stationary states, and the transitions from orbit to orbit influence radiation only by terminating the radiation characteristic of the first state and commencing that of the second. The strict law of conservation of energy does not hold, since the atoms do not change their energy while radiating, though the energy in the field of radiation increases during this interval; the atomic energy changes discontinuously during the transitions. There is, however, conservation of energy and of momentum, considering both the atomic energy and that of the radiation field, when an average is taken over a great number of atomic processes. The new suggestion is made that resonance radiation is to be identified with the radiation of the spherical wavelets which, by their interference with the external field, also produce absorption. Einstein's statement of the probabilities of the transitions of atoms is used, and the probability of interruptions of coherent vibrations is discussed. Detailed descriptions of the fields emitted, which consist of spherical wavelets with the frequencies of the various quantum lines which the atom can emit or absorb in its existing stationary state, are given, and it is shown how dispersion results. The assumptions made satisfy the correspondence principle, and the radiation field is essentially like that of the classical theory, which is known to agree generally with experiment. The theory gives a minimum value for the breadth of emission and absorption lines, which is the same for both classes and depends on the finite life of the wave-trains; Kirchhoff's law also holds for these lines. The applications of the new theory to emission of light by bombardment with electrons at the resonance potential, to resonance radiation and its quenching by foreign gases, and to absorption, scattering and dispersion are dealt with in a satisfactory manner.

TOTAL HEAT OF SUPERHEATED STEAM.—The electric lighting industry is looking forward to great improvements in steam generation in the boiler-house. During recent years the standard working steam pressures have risen from 200 lb. per sq. in. to 450 lb. per sq. in.; but much higher pressures are in use. The Edison Co. of Boston has boilers supplying steam at a pressure of 1200 lb. per sq. in. to a high back pressure turbo-generator. The exhaust steam is reheated to 700° F., and then enters a second turbine which is of ordinary construction. Engineers are contemplating even higher pressures. In the June issue of *World Power*, a valuable report by Prof. H. L. Callendar to the Electrical Research Association on the total heat of superheated steam at high pressures is published. Many conflicting tables have recently been published in Germany of the total heat at saturation. As a rule these have been obtained by extrapolating empirical formulæ representing small uncertain deviations at comparatively low pressures, little regard being paid to the well-known properties of fluids in the critical region. In this report Prof. Callendar describes a direct method of measuring the total heat which has already been applied successfully at moderate pressures and, provided the difficulty of regulating the pressure can be surmounted, there is no reason why it should not give with equal facility accurate results at the highest pressures obtainable. There are many advantages in the steady flow method of calorimetry which he adopts over the more ordinary methods. The difference of temperature to be measured is steady, and admits of direct observation by a single reading with a differential pair of platinum thermometers. No correction has to be applied for the water-equivalent which is so great a source of uncertainty at high temperatures. The flow of the fluid itself supplies sufficient stirring, and each part of the apparatus can be jacketed with its own flow. A discussion is given of the effect of time-lag in evaporation of nuclear drops. The primary object which the author has in view is the verification of the tables of the total heat near saturation, and his results will be of great value to the electrical industry.

Southampton Meeting of the British Association.

LOCAL ARRANGEMENTS.

THE week from Wednesday, August 26, to Wednesday, September 2, will see the British Association for the Advancement of Science at Southampton for the third time in its long history of ninety-five years. Twice in the past, in 1846 under the presidency of Sir R. I. Murchison, and also in 1882 under Dr. (afterwards Sir) Charles Siemens, has it met there, and this year will see it once again in Britain's premier passenger port under Prof. Horace Lamb, formerly of the University of Manchester. Arrangements have been made with British railways so that members of the Association attending the meeting may obtain return tickets to Southampton at the price of single fare and a third.

The Reception Room will be the King Edward VI. Grammar School, which is conveniently and centrally situated, facing the open space called the Marlands, on one side of which is the public stance for charabancs, while close behind it is the West Station on the main Southern Railway line from Waterloo to Weymouth, at which most of the visitors to the meeting will alight from their trains. For the convenience of the members it has been arranged with the railway authorities for a special train to be run from Waterloo on the day before the opening of the meeting (Tuesday, August 25). Within easy distance of the Grammar School are to be found the shops and restaurants of Above Bar Street, and an agreement has been reached with a firm of local caterers to take for the week of the visit the Coliseum, a hall capable of seating 1600, and run it as a restaurant at which lunches and teas may be had.

At the town end, within a short radius—half a mile at most—of the Reception Room, sections A, B, C, F, G, and M have found suitable accommodation. In the Free Library across the park from the Grammar School, C (Geology) comes nearest; opposite it, at the far corner of Brunswick Place and Dorset Street, A (Mathematics and Physics) occupies the Lamb Memorial Hall; farther up the street from the Free Library on the London Road we find in order B (Chemistry) at the Kell Hall, corner of Bellevue Road, and M (Agriculture) at the Friends' Meeting-House in Ordnance Road, immediately opposite the main entrance to the Ordnance Survey Office. In the opposite direction from the Reception Room, at the bottom of East Street, F (Economics) and G (Engineering) are housed in the new Wesleyan Central Hall, the auditorium of which will be the place of meeting for the presidential address on the evening of Wednesday, August 26, and also for the Children's and Citizens' Evening Lectures. The Royal Pier, in the pavilion of which the mayoral reception will be held on the evening of Thursday, August 27, is at a tramcar terminus not far from the south end of the High Street, which, passing northwards as Above Bar Street, London Road, and the Avenue, is the principal thoroughfare of the town. About the middle of the Avenue, section H (Anthropology) is located at the Avenue Hall, attached to the Avenue Congregational Church. The ordinary tramcar service passes by or very close to all these meeting-places, the last mentioned of which, the Avenue Hall, is the most distant, being about one mile from the Reception Room.

The remaining sections, D, E, I, J, K, and L, meet at the University College, Highfield; D (Zoology) in the main corridor to the right of the south entrance on the ground floor next to the Women's Common Room; E (Geography) in the Engineering block—associated with this section is the important exhibition of maps belonging to Sir George Fordham; I (Physiology) at the opposite end of the main corridor to D on the ground floor opposite the Men's Common Room; J (Psychology) in the Library and Senior Common Room on the first floor above I; K (Botany with the subsection of Forestry) on the first floor above D; and L (Education) in the newly built Assembly Hall opposite the College Refectory, where luncheons and teas may be had. This grouping of half the sections at the University College, which is rather remotely placed from the central Reception Room and is a good ten minutes' walk from the tramcar termini at either Bassett or Portswood, has necessitated for the convenience of the members a special bus service past the College buildings to join up with the rest of the town.

The University College has put its three hostels at the disposal of the Association. The largest, South Stoneham House, a Queen Anne mansion surrounded by beautiful grounds, will house the Secretariat; the next, Highfield Hall, will accommodate some sixty members as a hostel, and in the same way South Hill, a former residence of the Bishop of Southampton, about half that number. South Hill is situated some ten minutes' walk from the Bassett tramcar terminus or from the University College. Highfield Hall is on the Common, not far above the Avenue Hall; while South Stoneham, a former residence of Lord Swaythling, is at Swaythling, close to the car terminus and railway station of that name. It is fully two miles distant from the Reception Room and almost three miles from the Wesleyan Central Hall, though connected to both by electric tram service of some half an hour's duration.

Garden parties have been offered by Lord and Lady Swaythling at Townhill Park; Lord and Lady St. Cyres at Walhampton, near Lymington; and Mr. W. Collins at Westend; while the Cunard and White Star Companies, with their wonted generosity, have invited as many members as may care to go to see over one of their ships.

Southampton is remarkable for its fine open spaces, which stretch from the lower part of the town almost without break to the Southampton Common, the latter covering an area of more than 360 acres of virgin land. Its immediate environs include many places of great natural beauty. General excursions are being arranged to visit old Southampton, the Docks, New Forest, Stonehenge, and other places of interest in the neighbourhood. The full list of excursions, including sectional ones and visits to works, will be given later in detail. While tickets for the general excursions will be obtainable at a counter in the Reception Room, those for all the sectional excursions may be had from the local sectional secretaries at the various rendezvous of the sections during the week of the visit. The committee of the Royal Yacht Club has very kindly extended hospitality of honorary membership to the visiting members of the British Association.

Southampton, rich in historical associations, favoured by its geographical situation at the confluence of the rivers Itchen and Test, and unique in its modern commercial development, awaits the advent of the British Association into its midst with great interest. It is fully conscious of the honour conferred on it by such a visit, and is determined to make it the signal success which the occasion demands.

W. RAE SHERRIFFS.

Meteorology in the Republic of Colombia.

ON the occasion of the establishment of a new observatory at Bogotà, capital of Colombia, in connexion with a general reorganisation of official geophysics in the Republic, the director, the Rev. S. Sarasola, *S.J.*, is anxious that attention be directed to the first publication of the new institution (Notas Geofisicas y Meteorologicas, No. 1, Bogotà, 1924). This comprises a description of the new observatory, a history of previous observatories, in the work of which Baron Humboldt interested himself a century or so ago when travelling in South America, an account of the physical geography of Colombia, and a discussion of climatic, magnetic, and seismic conditions, together with copious meteorological statistics for Bogotà, at an altitude of about 9000 ft. on the eastern ridge of the Cordillera, and other cities.

Father Sarasola desires especially to make known that neither at Bogotà nor other places in this quarter of the globe does observation establish anything in the nature of a constant upper wind from the S.W. answering to the "anti-trade" of the text-books. It appears from the data relating to upper-cloud movements which are given, not only for Colombia, but also for neighbouring countries, including the West Indies, that the most prevalent direction of the upper current is S.E. rather than S.W. This, we would observe, is in conformity with the view that the real direction of the return or counter-trade in the northern hemisphere, at the equatorial limit, is S.E., becoming S.W. towards higher latitudes (see, for example, W. R. Blair's paper on the planetary circulation in the *Monthly Weather Review* for April 1916). But however this may be, we are really not surprised at Father Sarasola's failure to observe a constant anti-trade over Colombia, and we think that he may possibly be under some misconception as to the extent to which European meteorologists nowadays really believe in the *fixity* of the so-called trades and anti-trades. The fact of the matter is that these terms, though useful and proper generalisations from the facts of wind and pressure distribution as shown on mean or average charts, should not be applied too rigorously to actual momentary distributions without first of all formulating a definition of what a trade or anti-trade really is. Not only do the conventional trades moving round the flanks of the subtropical anticyclones shift their latitudinal limits with the seasons, but they also vary their position with changes in the day-to-day distribution of pressure, so that the task of identifying a given air-current as a "trade" would not always be possible without an exact definition which would be difficult to frame. We are therefore the more convinced, from the unfruitful search in Central and South America for the *stereotyped* anti-trade of the text-books, that the terms "trades" and "anti-trades," like "westerlies" of higher latitudes, should only be used in a generalised sense to denote the average trend of the circulation of the atmosphere within certain belts of latitude. At the same time we are fully aware that there are certain ocean tracts where unmistakable "trades" do blow very steadily for weeks on end in a way that the highly variable "westerlies" do not.

Since climate cannot be properly portrayed by statistics alone, which can never render local colour, it is pleasing to find Father Sarasola quoting a vivid description of a writer, Señor Caldas, of climatic conditions on the west coast of Colombia, which, with a mean annual rainfall of about 200 in., is one of the wettest regions of the globe. We render the passage from the Spanish: "It rains for the greater part of the year. Legions of clouds hurl themselves against the sky from the direction of the Pacific. The west wind, which reigns constantly over those seas, flings the vapours on to the continent where the Andes arrest them in full career. There the clouds accumulate and give the mountains a dark and menacing aspect. The sky vanishes, and on all sides appear nothing but heavy black clouds threatening all living creatures. An oppressive calm supervenes marking a terrible moment; then a hurricane of wind uproots immense trees, to the accompaniment of electrical explosions with dreadful crashes of thunder; the rivers leave their channels; the infuriated sea inundates the coast with gigantic waves; sky and earth are confused, and all seems to herald universal destruction. In the midst of so much turmoil the traveller turns pale; but the native of the Choco stays quietly at home in the bosom of his family, for long experience has taught him that the results of such convulsions of Nature are seldom mournful, that it is all nothing but light, water, and noise, and that within a few hours equilibrium and calm will be restored."

L. C. W. BONACINA.

Chlorocruorin.

THE study of the pigments occurring in Nature has shown that from both the hæmoglobin of animals and the chlorophyll of plants, substances of similar chemical constitution can be derived under the influence of appropriate reagents. These bodies are known as the porphyrins and are made up of pyrrol groups: but from this point the resemblance between hæmoglobin and chlorophyll ceases, since the former contains iron in its molecule, while magnesium is present in the latter; also the other groups present in the respective molecules and the functions of the substances themselves are different. How far the resemblance between these two pigments is significant is uncertain, since the details of the synthesis of hæmoglobin in the animal body are unknown, but it is possible that the pyrrol rings have some special property which serves as a useful basis on which to build up more complex substances with the peculiar properties of hæmoglobin and chlorophyll respectively. In this event the difference in their functions will be largely due to the other constituents of their molecules.

There appears to be no reason, however, why other substances derived also from the porphyrins should not be found in Nature, if compounds with similar, or possibly even dissimilar, properties to hæmoglobin or chlorophyll are required in the economy of the organism. An example is chlorocruorin, the green pigment in the plasma of certain polychætes (the Chlorhæmidæ and the Sabelliformia). H. Munro Fox (Proc. Cambridge Philosophical Society (Biological Sciences), 1924, vol. i. p. 204) has recently given an account of some of the properties of this substance. The specimen examined was obtained from the blood of *Spirographis Spellanzanii*: and although green in colour it is related to hæmoglobin, in that the porphyrin from which it is derived is the same as, or closely allied to, hæmatoporphyrin. The pigment exists in both the oxidised and reduced forms, and from it a series of derivatives can be obtained which resemble those obtained from hæmoglobin. The spectra of these derivatives are in many cases very similar to those of the parallel derivatives of hæmoglobin but with the bands shifted towards

the red end of the spectrum: in a few cases the resemblance between the derivatives is less close. Even when the protein part of the molecule has been removed, leaving the hæmatin derivative, the hæmatins are not the same, so that although each consists of porphyrin + iron, the method of combination must be different. Further divergence occurs when the protein is added to the iron-containing part of the molecule.

The chemical similarity between chlorocruorin and hæmoglobin suggests a similarity of function also. Indeed the author shows that chlorocruorin can act as a respiratory pigment, in that the oxidised form can be reduced by exposure to a vacuum or by living tissues. The amount of oxygen in the blood of Spirographis appears to be about one-third of that found in a similar quantity of human blood. The function, however, of this pigment in the economy of the worm is uncertain, since the blood does not undergo a complete circulation. Although it may not convey oxygen from the surrounding medium to the body tissues as hæmoglobin does, yet it may permit of a more active gas exchange and perhaps, at times, make the worm less dependent on the oxygen in the surrounding water. Chlorocruorin thus appears to be "a unique case of the parallel evolution of a substance resembling hæmoglobin".

University and Educational Intelligence

ABERDEEN.—Applications are invited from graduates of the University of Aberdeen for the Wilson Travelling Fellowship, which is for archæological and anthropological research in the near East, including the Balkan Peninsula, Asia Minor, Palestine, Egypt, and Mesopotamia. The fellowship is of the annual value of 300*l*., with a possible increase, and is tenable for two years. Applications must be received before August 1 by Mr. A. Martineau, 1 Golden Square, Aberdeen.

BELFAST.—At the Summer Graduation Ceremony of the Queen's University, held on Friday, July 10, Prof. F. G. Donnan of University College, London, received the degree of D.Sc. *honoris causa*. After a very distinguished career as an undergraduate of Queen's College, Belfast, Prof. Donnan obtained his degree with the highest honours in the late Royal University; and as professor of chemistry in the University of Liverpool and in University College, London, he has done work which has gained for him a foremost position amongst chemists. The degree of D.Sc. *honoris causa* was also conferred upon Prof. E. W. MacBride, professor of zoology of the Imperial College of Science and Technology, London. Prof. MacBride was a student and scholar of Queen's College, Belfast. He entered St. John's College, Cambridge, of which he became a fellow, and he also graduated with the highest honours in the University of London. His work as a zoologist at McGill University, Montreal, and the Imperial College, London, is well known.

BIRMINGHAM.—Sir Oliver Lodge has been appointed Huxley lecturer for session 1925–26, the subject of his lecture being "Difficulties of the Ether."

Dr. G. F. Still has been appointed Ingleby lecturer for 1926, and Dr. Leonard G. Parsons for 1927.

Prof. Leonard Gamgee has presented to the University a sum sufficient to provide a gold medal to be awarded annually to the candidate who passes the summer final examination for the M.B., Ch.B. degree and who gains the highest marks for surgery. The medal is to be called the Sampson Gamgee medal and is in memory of Prof. Gamgee's father, who worked for many years in the Birmingham Medical School.

Prof. T. Turner has been elected Dean of the faculty of science in succession to Prof. F. W. Burstall, his term of office beginning on September 1.

At the recent degree congregation there were conferred, among others, the following degrees:—D.Sc., 3; Ph.D., 5; M.Sc., 11; B.Sc. with Honours, 80; B.Sc. (Ordinary), 58.

EDINBURGH.—Prof. Shield Nicholson has resigned the chair of political economy, to which he was appointed in 1880.

The University Court at its meeting on June 15 approved the terms of an ordinance for the foundation of the Abercromby chair of archæology.

The resignation of Mr. J. F. Rees, reader in economic history, was received and was accepted with regret. The University Court congratulated Mr. Rees on his appointment to the chair of commerce in the University of Birmingham, recently vacated by Sir William Ashley.

Intimation was received of a legacy by Miss Catherine S. Howden of 5000*l*. to found a scholarship for research work, preferably in the domain of nervous diseases, and of a gift of 50*l*. by Mrs. John Harrison, to be applied in assisting the printing of research papers by members of the University.

Dr. J. M. Woodburn Morison of Manchester has taken up the duties of lecturer in electrical therapeutics and radiology, which is part of a new course in clinical pathology.

LONDON.—Prof. E. A. Gardner has been re-elected Vice-Chancellor for the year 1925–26.

The title of professor of mycology in the University has been conferred on Mr. E. S. Salmon in respect of the post held by him at the South-Eastern Agricultural College. The title of reader in mycology in the University was conferred on Mr. Salmon in 1912, and since that date he has published numerous papers on fungous diseases of plants and on fungicides.

The title of emeritus professor of hygiene and public health in the University has been conferred on Sir William J. R. Simpson, as from the end of the present session, on his retirement from King's College, after twenty-seven years' service, on the closing of the Department of Bacteriology and Public Health.

ST. ANDREWS.—M. Étienne Gilson, Professor of the Philosophy of the Middle Ages at the Sorbonne, Paris, has just published a text of René Descartes' "Discours de la Méthode" with a commentary. The volume is dedicated to the University of St. Andrews, which has recently bestowed the degree of LL.D. upon M. Gilson.

We learn from *Science* that Mr. G. E. Merrick has given 160 acres of land and a sum of 5,000,000 dollars towards the establishment of a university in Miami, Florida. The university, which was granted a charter on April 5, will be non-sectarian and co-educational.

APPLICATIONS are invited by the Royal College of Physicians for the Streatfeild Research Scholarship in medicine and surgery, the annual value of which will probably be 250*l*. and the tenure three years. Applications must reach the Registrar of the College, Pall Mall East, S.W.1, not later than October 1.

THE Dickinson Travelling Research Scholarship in medicine, which is open to students of the University and Infirmary, Manchester, has been awarded by the Trustees of the Manchester Royal Infirmary to Dr. Raymond Williamson and to Mr. Leslie J. Witts.

THE London School of Hygiene and Tropical Medicine is prepared to consider from qualified medical practitioners applications for four research

studentships in tropical medicine and hygiene. The studentships are each of the value of 250*l.* yearly and will normally be for two years. The latest date for the receipt of applications, which should be sent to the Secretary of the School, 23 Endsleigh Gardens, N.W.1, is August 31.

APPLICATIONS are invited by the council of the University College of the South-West of England, Exeter, for the Andrews Simons research studentship, value 120*l.*, for the furtherance of experimental research in physics, chemistry, or other branch of science. The applications must be received by the Registrar not later than August 1.

THE Royal Commissioners for the Exhibition of 1851 have made the following appointments to Senior Studentships and Overseas Scholarships for 1925:—*Senior Studentships*: Mr. O. M. B. Bulman, Imperial College of Science and Technology (Geology); Mr. P. A. M. Dirac, Cambridge (Mathematical physics); Mr. I. R. McHaffie, University College, London (Physical chemistry); Mr. H. W. B. Skinner, Cambridge (Physics); and Mr. D. L. Thomson, University of Aberdeen (Bio-chemistry). *Overseas Scholarships*: Mr. C. L. Huskins, Alberta (Cytology); Mr. A. R. Fee, British Columbia (Biology); Mr. C. S. Hanes, Toronto (Biology); Mr. J. G. Wood, Adelaide (Botany); Mr. V. M. Trikojus, Sydney (Organic chemistry); Mr. S. W. Watson, South Africa (Physics); Mr. R. S. Allan, New Zealand (Geology); and Mr. J. J. Lennon, University College, Dublin (Organic chemistry).

THE Ramsay Memorial Fellowships for chemical research are administered under a scheme framed on an international basis, the participating countries being Great Britain and Ireland, Canada, Denmark, France, Greece, Italy, Japan, the Netherlands, Norway, Spain, Sweden, and Switzerland. The fellowships, sixteen in number, are tenable in any university or other place in the United Kingdom possessed of the requisite facilities for research. In a speech made in response to the toast of the trustees of the Ramsay Memorial Fellowships proposed by Sir William Bragg at a dinner given at University College, London, on July 3, Sir Robert Hadfield expressed the opinion that the bringing into our midst of young chemists selected from other countries to undertake research work has been a great success in promoting friendly relations and mutual understanding between men of science of different countries. He quoted with approval a suggestion made by a former fellowship holder, Prof. Henri Weiss of the University of Strasbourg, that the fellowships should be extended and young British skilled research workers should be sent to foreign universities. This theme—the rôle of the *savant* abroad as not only purveyor of light but as promoter of peace and goodwill—is one on which quite a number of public pronouncements have been made in Great Britain during the past six months by eminent men of science, and it was discussed at length at the annual conference of the Universities of Great Britain and Ireland on May 9. In the United States likewise it has been much discussed and large sums of money have been appropriated to translating aspirations into actualities, such as the John Simon Guggenheim Memorial Foundation, to which a "preliminary" gift of 3 million dollars has been made, to provide annually from forty to fifty fellowships for "advanced study abroad." The American Council on Education has published in the *Educational Record* for April a list of seventy-six organisations interested in such relations, and proposes to invite them all to a conference to be held at Washington in the autumn.

Early Science at Oxford.

July 21, 1685. Mr. President being in the Chair acquainted the Society that in Northamptonshire about two or three miles from Astrop, there is dug a heavy black earth, which being calcined comes to a black sand, some of which he was pleased to shew us, almost as heavy as ye earth: A Magnet being applied to this sand, was seen to attract it.

A letter of Mr. Leewenhoeck's concerning ye Generation of man &c: from an insect was read.

Dr Bernard presented some papers of Mr. Greaves giving an account of some experiments made at Woolwich in ye year 1651 for ye triall of great guns.—The Doctor also presented ye Society with a *Cornu Ammonis*, some *Belemnites*, *Lignum fossile*, *Ostracites*, all which were dug out of a well on a hill near Faringdon.

A Letter from Mr. Aston dated July 15 was read; it affirmes ye true Zaffer is nothing but Kobalt calcined, ye comon Zaffer being adulterated with pebbles.

Dr. Plot presented a Persian wood, which was observed to sink in water; and a Hen's egge sent him from out of Yorkshire, having a round hole at one end of about half an inch diameter: this hole was exactly fitted by a little cap of ye same matter with ye rest of ye shell, but more protuberant, than ye end of an Egg-shell is naturally, and full of wrinkles; the Cap is said not to have been continued to ye main body of ye shell, but sticking close by its inner side to ye membrane, was by these meanes kept as a cover on ye hole.

A letter from Mr. Cole of Bristoll, dated July 16th, was communicated by Dr. Plot and read.

July 22, 1684. Two Letters from Mr. Aston, one dated July ye 10, ye other 17, were read: An Abstract of a Letter from Dr Huntingdon sayes, that Mr. Tennant, a gentleman in Ireland, has lately invented an Engin for ye throwing of water, far exceeding that of Sir Samuel Moreland.

Some of ye curiosities lately presented to ye University by Mr. Cole of Bristol, were communicated to ye Society by Dr. Plot; as first, Sal Gemmæ from St. John de Port Rico, one of ye Leeward Islands near Jamaica. It breaks generally into squares; is transparent near four inches thick, so that at that thickness ye motion of a finger, playing up and down, may easily be discerned. Secondly, Silk Grass of three yards long found in ye swomps, or moorish grounds, in Virginia, growing upon a tall plant from which it is strip't like Hemp. Thirdly Neopolitan black writing sand, which applyed to ye Magnet in great quantitys, and much more readily than ye *ferrum Noricum*, or any other ore we have yet seen. Some of this sand being calcined by Dr. Plot, ran into a mass, which, when cold, was very brittle. Other experiments will be tried on this sand by ye Doctor, of which we are promised an account.

Mr. Conningham affirms, that Sal Gemmæ is commonly thrown up by ye Lammas floods within six miles of St. Andrews, and used by ye poor people instead of common salt.

A letter from Mr. Flamsteed to Mr. Caswell, concerning ye late eclipse of ye Sun, and ye *Maculæ Solis* observed by him, was read. This great Astronomer does, in this letter, seem to question, whither these spots, seen by him, were not two differing spots, rather than revolutions of ye same spot; altho ye manner of their course along ye disc of ye Sun, seems to be much alike, and therefore argues ye latter.

Societies and Academies.

LONDON.

Royal Meteorological Society, May 20.—F. W. **Harmer** and C. E. P. **Brooks**: Further remarks on the meteorological conditions of the Pleistocene epoch. The chief difference between the North Atlantic and North Pacific Oceans is that the former is open to the north, while the latter is practically closed to the north. Hence in the Atlantic the Gulf Stream travels north-eastward into the Arctic Ocean, while in the Pacific the Japan current is forced to turn south-eastward along the coast of America. This difference causes differences in the pressure distribution; both oceanic and atmospheric circulation combine to give western Europe a more genial climate than the west of North America. The closing of the Greenland-Europe channel would bring about changes in the oceanic and atmospheric circulations which would suffice to cause a glacial epoch in Europe. The diversion of the storm tracks and the consequent alteration in the direction of the prevalent winds are probably even more important than the changes in the currents. The second part of the paper deals with the climatic changes in the Mediterranean region during the glacial period, the crowding together of the isotherms in southern Europe caused a great increase of storminess there, to which was due the torrential rains of which we have evidence.—Sir Gilbert T. **Walker**: On periodicity. Proposals that have been made in recent years for modifying Schuster's periodogram; a new criterion for the reality of a period, with some applications to meteorological data, is given.—Harold **Jeffreys**: On fluid motions produced by differences of temperature and humidity. It has been shown that the maintenance of a difference of temperature between parts of the same level surface in a fluid will necessarily maintain a permanent motion of the fluid, and that heating or cooling a fluid at an internal boundary will also maintain a permanent movement. A corresponding theorem is true for the supply of new constituents instead of heat. This result appears to contradict a theorem given by Sandstrom and Bjerknes, to the effect that a permanent motion is possible only if the place where the heat is supplied is at a lower level than that where it is removed; but the arguments of these authors involve an unstated assumption, which seems to be untrue. Sandstrom's experiment, in which no motion was observed in a tank under conditions suited to the production of a circulation, is capable of a dynamical explanation based on the slowness of conduction and the consequent confinement of the currents to narrow regions where they would be very difficult to observe. It appears unlikely that it will often be possible to proceed by analogy from this experiment to the dynamics of wind, for radiation and turbulence will always redistribute the heat in such a way as to produce general currents; but there may be some applications to ocean currents.—A. H. R. **Goldie**: Gustiness of wind in particular cases. Deals particularly with examples from the anemograph records of Falmouth Observatory during periods of S.W. wind. It was found that the time interval of the rise and fall of the anemograph pen and of the breaking of the waves on the shore approximated to seven seconds. A further investigation at Lerwick showed that the normal relation between "range of gusts" and "hourly mean wind," in the case of equatorial currents, is about one-third and nearly independent of velocity.

SHEFFIELD.

Society of Glass Technology, May 25 and 26.—W. E. S. **Turner**: The nature and constitution of glass. The abnormal properties recently observed in glass when heated in the annealing range (such as greatly increased thermal expansion, heat absorption, and modification of specific electrical conductivity; and the changes of density and refractive index on heat treating glass) have their counterpart in the changes of plasticity which glass exhibits when remelted or when the raw materials have considerable quantities of moisture or of certain salts present. Two fundamental factors are involved; molecular complexity and the presence of compounds in glasses.—G. **Tammann**: On glasses as supercooled liquids. A discussion of the influence of degree of undercooling, nucleus number, viscosity and other factors on the production of the glassy state. The customary soda-lime-silica glasses may be regarded as ternary mixtures of Na_2SiO_3, $CaSiO_3$ and SiO_2. The two components Na_2SiO_3 and $CaSiO_3$ crystallise readily, as do their mixtures, from which mixed crystals separate. With an excess of silica the nucleus number of these mixed crystals is reduced extraordinarily, so that mixtures with an excess of 8 per cent. of silica or more solidify as glasses.—A. Q. **Tool** and E. E. **Hill**: On the constitution and density of glass. A glass is intermediate between the liquid and solid states. Its condition at ordinary temperatures may be considered as undercooled, not alone with regard to the process of crystallisation, usually known as the true solidification, but also with respect to the completion of many processes normal to the vitreous condition. The maximum density change observed was 1·10.—G. W. **Morey** and N. L. **Bowen**: The ternary system sodium metasilicate-calcium metasilicate-silica. The following new compounds have been found and their properties determined. The compound $2Na_2O$, CaO, $3SiO_2$, which melts incongruently, forming a liquid richer in Na_2SiO_3 and Na_2O, $2CaO$, $3SiO_2$; the compound Na_2O, $2CaO$, $3SiO_2$, which has a congruent melting point at 1284°; and the compound Na_2O, $3CaO$, $6SiO_2$, which melts incongruently at 1045°, forming a mixture of wollastonite and a glass containing approximately 15 per cent. CaO, 67 per cent. SiO_2.—R. W. G. **Wyckoff** and G. W. **Morey**: X-ray diffraction measurements on some soda-lime-silica glasses. (A preliminary note.) In some instances the broad bands thought to be characteristic of glasses have been found. In others narrow bands or lines have been obtained which are as sharp as the lines produced by crystals of colloidal dimensions.—Sir W. H. **Bragg**: The structure of quartz. Quartz changes its structure on passing through 575°. The high-temperature quartz is more symmetrical than the low, but the change is not severe. The four unknown quantities in low-temperature quartz reduce to one on passing to the high-temperature form; the silicon atoms are fixed, and the oxygen atoms must lie on certain straight lines. Attempts to fix the positions of the oxygen atoms can be made, based on intensity measurements. The most probable value shows, somewhat unexpectedly, that each silicon atom is at the centre of a regular tetrahedron of which the four corners are occupied by oxygen atoms. Assuming that the low-temperature quartz is not very different from the high-temperature quartz, the various twinnings of quartz are readily accounted for.—Vaughan H. **Stott**: The viscosity of glass. Final relations between viscosity and composition, in which errors due to impurities or inaccurate compositions generally are not considerably greater than the errors of the viscosity determinations

themselves, cannot be obtained unless the glasses are prepared from materials of known purity and melted without contamination. This at present precludes the melting of large pieces of glass, and limits the design of viscosimeters

PARIS.

Academy of Sciences, June 15.—The president announced the deaths of Louis Gentil and Dr. Depage.—A. **Haller** and René **Lucas**: The rotatory powers of certain derivatives of camphor. Seven derivatives of camphor were studied. The specific rotatory powers were measured for seven wave-lengths (γ=6708 to 4358) in four solvents (alcohol, benzene, carbon disulphide, cyclohexane). The rotatory power varied considerably with the solvent. —J. **Costantin**: An old asymbiotic culture at the *Muséum*.—Louis **Lumière**: Concerning the invention of the kinematograph. A claim for priority.—J. **Haag**: The probability in a circle.—Bertrand **Gambier**: Surfaces of which a finite or infinite number of asymptotics belong to a linear complex.—Maurice **Fréchet**: Abstract point transformations.—N. **Lusin**: The properties of projective ensembles.—P. J. **Myrberg**: Automorph functions.—B. **Galerkin**: The tensions of a prism having a rectangular isosceles triangle as base.—Paul **Woog**: Measurements of oily friction. Data are given for various oils, either alone or with the addition of fatty acids.—André **Metz**: A relativist definition of simultaneity.—T. **Peczalski** and G. **Mokrzycki**: Study of chemical compounds of salts in the electric arc. The distance between the electrodes of the arc and the intensity of the current were kept constant. Mixtures of oxides were placed in a crater on the positive electrode and the fall of potential measured. The curve obtained by plotting composition of the salt mixture against the volts indicated the formation of compounds.—N. **Pariselle**: Contribution to the study of the rotatory power and dispersion in the terpene series.—N. **Pauthenier**: The rotating arc between carbon electrodes.—Marcel **Peschard**: The magnetisation of ferro-nickel: saturations and atomic moments. —Jean Jacques **Trillat**: Study of soaps and fats by means of the X-rays.—A. **Boutaric** and Mme. Y. **Janière**: The influence of very small quantities of foreign substances on the stability of colloidal solutions. The addition of a small quantity of an electrolyte to a colloidal suspension may protect the solution against the flocculating action of an electrolyte, may accelerate the flocculation, or may be without effect. The results of experiments with two different electrolytes on a colloidal solution of sulphide of arsenic are given in the form of a table.—C. **Damiens**: An artificial magnesium silicate.—V. **Auger** and T. **Karantassis**: Researches on the complexes of stannic iodide. The compounds Rb_2SnI_6, Cs_2SnI_6, and $[As(CH_3)_4]_2SnI_6$ have been isolated.—P. **Lebeau** and P. **Marmasse**: The estimation of carbon dioxide and carbon monoxide. The carbon dioxide is removed by cooling with liquid air, which at the same time removes higher homologues of methane, ethylene, acetylene, and other gases likely to interfere with the iodine pentoxide reaction. The gas is then passed over iodine pentoxide at 150° C. and the carbon dioxide resulting from the oxidation of the monoxide again removed at −190° C. The method has been applied to the determination of carbon monoxide in commercial hydrogen and also to the search for carbon monoxide in gases from borings at Pechelbronn: the results in the last-named gases were negative. Air gave traces of carbon monoxide (less than 5 parts per million).—Paul **Pascal**: New complexes of iron derived from the triazines.—Charles **Prévost**: Methylphenylbutadiine.—P. **Gaubert**: The spherolites of reamurite.—Louis **Longchambon**: The polymorphic transformations of silica.—Jacques de **Lapparent**: The relations between the hydrocarbons and carbonates in silex and the phtanites.—Maurice **Jean**: The nature of the internal liber of the seedling of *Convolvulus tricolor*.—A. **Tronchet**: Polycotyly and schizocotyly in *Dimorphotheca pluvialis*.—M. **Bridel** and P. **Picard**: The preparation and properties of monotropitoside. 60 grams of this glucoside have been extracted from 20 kilograms of bark of *Betula lenta*. Full details of its physical and chemical properties are given. It furnishes methyl salicylate, glucose, and xylose on hydrolysis.—René **Jeannel**: The homologies of the articulations of the leg in insects.—Stéphane **Dombrowski**: The permanent regimes of concentration in a convection current and its application to physiology.—Alphonse **Labbé**: The curves of growth of *Artemia arietina*.

ROME.

Royal Academy of the Lincei, April 4.—Leonida **Tonelli**: Problem of primitive functions.—Gabriella Armellini **Conti**: Observations of the position of the planet Uranus on the occasion of its conjugation with 96 Aquari.—O. M. **Corbino** and E. **Persico**: Secondary oscillations in a generator with a three-electrode lamp. —A. L. **Herrera**: Photomicrographs showing karyokinesis figures in metaformaldehyde crystals.—F. **Sbrana**: Characteristic property of polyharmonic functions and solutions of the equation of vibrating membranes. — Umberto **Crudeli**: Rutherford-Bohr triangular systems in relative equilibrium.—D. J. **Struik**: Irrotational waves in channels.—G. **Ponte**: Vulcanological investigations. Vulcanism causes a gradual impoverishment on the earth, not only of atmospheric oxygen but also of water vapour, similar to that which seems to have taken place with greater intensity on the moon.—E. **Adinolfi**: Influence of X-rays on the crystallisation of bismuth. X-rays exert on bismuth, during its crystallisation, an effect similar to, but distinct from, that caused by impurities, and varying with the hardness of the rays used.—Enrico **Fermi**: Relation between the constants of the infra-red bands of triatomic molecules. For these molecules, the three atoms of which must lie in one plane, the expression

$$\frac{1}{\Delta\nu_1} = \frac{1}{\Delta\nu_2} + \frac{1}{\Delta\nu_3}$$

is deduced for the relationship between the constant frequency differences of the lines in the infra-red band. The only triatomic molecule for which the necessary data are available is that of water vapour, and in this case the above equation holds within the limits of experimental error.—U. **Sborgi**: Electronic theory of the anodic behaviour of metals, especially of those exhibiting passivity phenomena.—G. **Malquori**: Mixed silver-copper basic salts. Investigation of the system $Cu(OH)_2 - AgNO_3 - H_2O$ indicates the existence of only one mixed basic salt, which has the composition $3\,Cu(OH)_2, 2AgNO_3, 3H_2O$, and is stable in the presence of silver nitrate solution of concentration not lower than 0·78 per cent.—Luigi **Settimj**: Transformation of nitrogen compounds (proteins) in preserved food produce. In food materials, whether tinned or in contact with the air, the insoluble nitrogen compounds undergo gradual transformation with production of an equivalent quantity of soluble nitrogen compounds. —P. **Pasquini**: Further considerations on the formation of the pecten in the development of the eye of *Gallus domesticus*. The evolution of the pecten in the development of the fowl's eye consists in a gradual lamination of the original pecten with consequent increase in its height in the vitreous humour; further, the lamina develops longitudinal folds, which increase its surface of contact with the vitreous body.—Umberto D'Ancona: Nerve endings in the somatic muscles of the decapod crustaceans.

Official Publications Received.

Annales de l'Observatoire Royal de Belgique. Troisième Série, Tome 2, Fascicule 1. Publié par P. Stroobant. Pp. 74. (Tournai: Imprimerie des Établissements Casterman S.-A.)

Studies from the Plant Physiological Laboratory of Charles University, Prague. Edited by Prof. Dr. B. Němec. Vol. 2, 1924. Pp. 106+5 plates. (Prague.)

Carnegie Institution of Washington: Eugenics Record Office. Bulletin No. 24: Body Build; its Development and Inheritance. By C. B. Davenport. Pp. 42. (Cold Spring Harbor, Long Island, N.Y.)

City and County of Kingston upon Hull, the Third Port of the United Kingdom. By T. Sheppard. (British Empire Exhibition, Wembley, 1925: Hull Civic Fortnight, July 7th to 20th.) Pp. 40+10 plates. (Hull.)

Memoirs of the National Academy of Sciences. Vol. 20: The American Oaks. By William Trelease. Pp. v+255+420 plates. (Washington: Government Printing Office.) 3.25 dollars.

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 6, 1924. 2: Nederbörden i Sverige. Pp. 159. (Stockholm.) 5 kr.

Annals of the (Mededelingen van het) Transvaal Museum. Vol. 11, Part 2, containing: Native Dolls in the Transvaal Museum, by A. Radcliffe Brown; 1: Initiation of Girls in the Masiyeni District, Portuguese East Africa, 2: Note on the Decorations on Carved Wooden Food-Bowls from South Chopiland, Portuguese East Africa, 3: On some Ritual Objects of the Vandau in South Chopiland, Gaza, Portuguese East Africa, by E. Dora Earthy; On the Development of the "Epipubis" of *Xenopus*, by Dr. C. G. S. de Villiers. Pp. 99-135+plates 9-26. (Cambridge: Printed at the University Press.)

Department of the Interior: U.S. Geological Survey. Bulletin 751: Contributions to Economic Geology (Short Papers and Preliminary Reports), 1923-24. Part 2: Mineral Fuels. Pp. vi+821-826. Bulletin 760-C: Erosion by Solution and Fill. By Willis T. Lee. (Contributions to the Geography of the United States, 1923-24.) Pp. ii+107-121+plates 23-30. Bulletin 780-A: The Melrose Phosphate Field, Montana. By R. W. Richards and J. T. Pardee. (Contributions to Economic Geology, 1925, Part 1.) Pp. iv+32+2 plates. Water-Supply Paper 520-F: Temperature of Water available for Industrial Use in the United States. By W. D. Collins. (Contributions to the Hydrology of the United States, 1923-1924.) Pp. ii+97-104+plates 8-11. Water-Supply Paper 520-G: Some Floods in the Rocky Mountain Region. By Robert Follansbee and Paul V. Hodges. (Contributions to the Hydrology of the United States, 1923-1924.) Pp. ii+10-129+iv. Water-Supply Paper 523: Surface Water Supply of the United States, 1921. Part 3: Ohio River Basin. Pp. vi+316+2 plates. 30 cents. Water-Supply Paper 531: Surface Water Supply of the United States, 1921. Part 11: Pacific Slope Basins in California. Pp. vii+304+2 plates. 25 cents. Water-Supply Paper 536: Surface Water Supply of the New-Kanawha River Basin, West Virginia, Virginia and North Carolina. Pp. iv+282+2 plates. 35 cents. Water-Supply Paper 539: Geology and Ground-Water Resources of Townsend Valley, Montana. By J. T. Pardee. Pp. iv+60+2 plates. 15 cents. (Washington: Government Printing Office.)

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University (Publications de la Faculté des Sciences de l'Université Masaryk). Čís. 47: Systém vodních toků na základě odtoku (Le système des eaux courantes d'après leur débit d'eau). Napsal Dr. Fr. Kolaček. Pp. 97. Čís. 48: Bromonovakain (La bromo-novocaine). Napsali J. Frelka a J. Vitha. Pp. 22. Čís. 49: On the Growing Reactions, produced by the Change of Hydrogen-Ion Concentration in Germinating Roots of *Pharbitis hispida* Choisy. By Ferd. Heršík. Pp. 21. Čís. 50: Sur les probabilités géométriques. Par B. Hostinský. Pp. 26. Čís. 51: Výklad vzniku krátkých elektromagnetických vln v elektronových lampách (An Explanation of the Origin of Short Electromagnetic Waves in Valves). Napsal Dr. Josef Sahanek. Pp 28. Čís. 53: La valeur osmotique et la réaction actuelle de l'eau du Golfe de Villefranche, à quel point sont elles constantes? Par Vladimír Moravek. Pp. 11. Čís. 54: Studie o inteligenci kočky, 2 (Studies on the Intelligence of the Cat, 2). Napsal Dr. Vladimír Teyrovský. Pp. 48. (Brno.)

British Museum (Natural History) Famous Naturalists. Series No. 1, Set H.2. 10 post cards in monochrome. (London: British Museum (Natural History).) 1s.

Bulletin of the American Museum of Natural History. Vol. 52, Art. 2: Scientific Results of the Expedition to the Gulf of California in Charge of C. H. Townsend, by the U.S. Fisheries Steamship *Albatross*, in 1911. 15: The Amphipoda collected by the United States Fisheries Steamer *Albatross* in 1911, chiefly in the Gulf of California. By Clarence R. Shoemaker. Pp. 21-61. (New York.)

The Iwata Institute of Plant Biochemistry. Publication No. 1: Untersuchungen über den Japanlack. Von Prof. Rikō Majima. Pp. x+154+3 Tafeln. (Tokyo.) 2.50 dollars.

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 24-25: X-ray Analysis of the Solid Solutions of Potassium Chloride and Potassium Bromide, by T. Sasahara; X-ray Analysis of Electrolytic Brass, by H. Nakamura. Pp. 277-292. 35 sen. No. 26: On the Mercury Line 2270A ($1S-2p_1$). By T. Takamine and M. Fukuda. Pp. 293-298. 25 sen. No. 27: Condensation of Nitriles with Thiamides. 4: Thiamide with Anliiminochlorides. By S. Ishikawa. Pp. 299-304. 25 sen. (Tokyo: Komagome, Hongo.)

Meddelelser fra Kommissionen for Havundersøgelser. Serie Fiskeri, Bind 7, Nr. 7: On the Fishery of the Greenlanders. By Ad. S. Jensen. Pp. 39. 3 kr. Serie Fiskeri, Bind 7, Nr. 8: On the Influence of the Currents upon the Frequency of the Mackerel in the Kattegat and adjacent parts of the Skagerak. By Dr. A. C. Johansen. Pp. 26. (København: C. A. Reitzel.)

New South Wales. Department of Mines: Geological Survey. Mineral Resources No. 33: The Gypsum Deposits of New South Wales. By Leo J. Jones. Pp. 45+14 plates. 2s. 6d. Bulletin No. 13: Chromium, Cobalt, Nickel; Zirconium, Titanium, Thorium, Cerium. By H. G. Raggatt. Pp. 17. 1s. Bulletin No. 14: Asbestos, Emery, Fluorspar, Fuller's Earth, Graphite, Phosphates, Talc, and Soapstone. By H. G. Raggatt. Pp. 31. 1s. Bulletin No. 15: Diatomite; Siliceous Earths' Sands. By E. J. Kenny. Pp. 18. 1s. (Sydney: Alfred James Kent.)

Lady Minto's Indian Nursing Association. Report for 1924. Pp. 167. (Simla.)

Year-Book of the Department of Agriculture, Ceylon, 1925. Pp. ii+52+8 plates. (Peradeniya, Ceylon.)

University of Illinois Engineering Experiment Station. Bulletin No. 147: Investigation of Antennae by Means of Models. By Prof. J. Tykocinski-Tykocinar. Pp. 60. (Urbana, Ill.) 35 cents.

New York Zoological Society. Report of the Director of the Aquarium. (Reprinted from the Twenty-ninth Annual Report of the New York Zoological Society.) Pp. 15. (New York.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 18, N.S., Nos. 5-9. 5: The Interpretation of certain Empirical Standards in their Application to Irish Butter, by George Brownlee; 6: The Theory of Variation of Flow in Pipe-lines with Surge Chambers consequent on Variation of Load on Hydraulic Turbines operated Therefrom, by H. H. Jeffcott; 7: The Variations in the Quantity of Food required by Cattle for Maintenance and Fat Production with different Kinds of Rations, by James Wilson; 8: The Identity of Vitamin A. The Comparative Effects of Human and Cow's Milk, by Harold Pringle; 9: On the Photo-electric Measurement of Submarine Illumination, by H. H. Poole. Pp. 49-115. (Dublin: Royal Dublin Society; London: Williams and Norgate, Ltd.) 5s.

Report of the Fourth International Seed Testing Congress: Compte rendu du 4me Congrès international d'essais de semences: Bericht über den IV Internationalen Kongress für Samenprüfung: in/à Cambridge (England), 7-12 VII 1924. Pp. 227. (London: H.M. Stationery Office.) 11s. 6d. net.

Diary of Societies.

SATURDAY, JULY 18.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (at Town Hall, Folkestone), at 11 A.M.—A. E. Nichols: Municipal Works at Folkestone.—E. C. Fawcett: Folkestone's New Sea Outfall Works.

BIOCHEMICAL SOCIETY (jointly with the Agricultural Education Association) (at University College, Reading), at 5.—Prof. R. H. A. Plimmer: The Action of Nitrous Acid upon Amides and some Amino Compounds.—W. J. N. Burch: Some Esters of Phosphoric Acid.—Mattick and Wright: The Influence of Administration of certain Salts on the Inorganic Constituents of Milk.—E. Ponder and W. W. Taylor: The Conductivity of Cell-suspensions.—G. D. Thacker and J. R. Marrack: The State of Calcium in Body Fluids.

MONDAY, JULY 20.

ROYAL SANITARY INSTITUTE (at Edinburgh), at 5.—Sir John Gilmour, Bart.: Inaugural Address.

TUESDAY, JULY 21.

ROYAL SANITARY INSTITUTE (at Edinburgh), at 10 A.M.—Meetings of Sections and Conferences: Sanitary Science, Industrial Hygiene, Engineers and Surveyors, Sanitary Inspectors.—At 8 P.M.—Sir Leslie Mackenzie: The Problem of Psycho-physical Fitness (Lecture).

BRITISH MEDICAL ASSOCIATION (Annual Meeting) (at Bath).

WEDNESDAY, JULY 22.

ROYAL SANITARY INSTITUTE (at Edinburgh), at 10 A.M.—Meetings of Sections and Conferences: Sanitary Science, Personal and Domestic Hygiene, Representatives of Sanitary Authorities, Medical Officers of Health.

BRITISH MEDICAL ASSOCIATION (Annual Meeting) (at Bath).

THURSDAY, JULY 23.

ROYAL SANITARY INSTITUTE (at Edinburgh), at 10 A.M.—Meetings of Sections and Conferences: Engineering and Architecture, Maternity and Child Welfare (including School Hygiene), Port Sanitary Authorities, Veterinary Inspectors, Health Workers.—At 8 P.M.—Dr. C. Porter: The Citizen and the Citizen's Health (Popular Lecture).

BRITISH MEDICAL ASSOCIATION (Annual Meeting) (at Bath).

FRIDAY, JULY 24.

ROYAL SANITARY INSTITUTE (at Edinburgh), at 10 A.M.—Meetings of Sections and Conferences: Engineering and Architecture, Maternity and Child Welfare (including School Hygiene), Veterinary Inspectors, Health Visitors.

ROYAL ASTRONOMICAL SOCIETY, at 4.30.—Special General Meeting.

ARISTOTELIAN SOCIETY, MIND ASSOCIATION, AND OXFORD PHILOSOPHICAL SOCIETY (Joint Session) (at Balliol College, Oxford), at 5.—Annual General Meeting of the Mind Association.—At 8.30.—Prof. H. Wildon Carr, Prof. A. Wolf, and Prof. C. Spearman: Symposium: The Nature of Intelligence.

BRITISH MEDICAL ASSOCIATION (Annual Meeting) (at Bath).

SATURDAY, JULY 25.

ARISTOTELIAN SOCIETY, MIND ASSOCIATION, AND OXFORD PHILOSOPHICAL SOCIETY (Joint Session) (at Balliol College, Oxford), at 10 A.M.—C. R. Morris, Dr. Dorothy Wrinch, and Prof. L. J. Russell: Symposium: The Concept of Energy.—At 2.30.—Dr. Ivy Mackenzie: The Biological Basis of the Sense of Time.—At 8.30.—Prof. J. A. Smith, Prof. A. D. Lindsay, and Dr. F. C. S. Schiller: Symposium: Croce's Theory of the Practical Nature of Science.

SUNDAY, JULY 26.

ARISTOTELIAN SOCIETY, MIND ASSOCIATION, AND OXFORD PHILOSOPHICAL SOCIETY (Joint Session) (at Balliol College, Oxford), at 2.30.—P. E. More, Prof. W. D. Ross, and Prof. G. Dawes Hicks: Symposium: Plato and Aristotle.—At 4.30.—J. MacMurray, C. E. M. Joad, and A. H. Hannay: Symposium: Is Art a form of Expression or of Apprehension?

SATURDAY, JULY 25, 1925.

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The Future of the British Patent Office.

I.

THE British patent system suffers from certain rather serious defects which prevent it from fulfilling adequately its function as a stimulus to invention and as an incentive to the development of new manufactures. It is the purpose of the present article to discuss one of these defects, namely, the restricted character of the investigation for novelty which is carried out by the Patent Office, and to direct attention to the need for fresh legislation on this subject. Wide differences of opinion are likely to exist as to the form the remedy should take, since the relative cost of any schemes which may be put forward will depend on the degrees of thoroughness characterising the searches for which they respectively provide. The view here advocated is that an extremely high degree of thoroughness will repay the expenditure which it involves, but we shall have served our purpose if we succeed in directing attention to the principal questions on which a decision will have to be taken when the present state of the law comes to be amended.

At the present time the situation in Great Britain is as follows. When a capitalist proposes to work a given patent, it is necessary for him to expend a certain outlay in plant, buildings and business organisation. Before taking the financial risk involved, he naturally desires to have some degree of assurance that he can uphold his patent in the courts, that it will not be invalidated after he has committed himself irrevocably to his venture. In the present state of the system, quite apart from the possibility of "prior user," which plays a small and diminishing part in such matters, and of "lack of subject matter," which does not entitle the patentee to much sympathy, he cannot have any such assurance. For at any time after a patent has been granted by the Patent Office, it may be invalidated on the ground that, unknown to the patentee, an invention similar to his had previously been "made available to the public in some document published in the United Kingdom," such as a foreign patent specification or a technical journal.

This state of affairs is keenly felt in manufacturing circles at the present time. It discourages the investment of capital in new manufactures at a time when unemployment and foreign competition demand the fullest exploitation of new means for creating wealth, and it hampers inventors in turning to advantage their patent rights. It is true that as regards anticipation by prior British specifications of the previous fifty years, the Patent Office does make a search which is marked by characteristic British thoroughness, but that search is a good thing spoiled, for it covers only a

fraction of the documents from which anticipations may afterwards emerge.

Various remedies for this state of things might be proposed. For example, if the Comptroller were simply to be empowered to enforce amendment to meet what are now called "extra-statutory citations," probably some sort of an extended search would be evolved in the course of a few decades, in an attempt to give fuller effect to these new powers. Or again, as Mr. W. J. Tennant once suggested,[1] the British search might be abandoned and the staff might devote itself to the formation of a universal index, in which applicants or their agents could search for themselves over a wide field. Or if the present examining staff were to be diluted with personnel of inferior qualifications working under its direction, a comprehensive search of moderate cost and low efficiency could be instituted within a reasonable time. We suggest, however, that the thing is worth doing well, and that means of a practicable character can be found to meet the cost of a far more ambitious scheme. We propose that the Patent Office should undertake to search over substantially the whole area in which anticipating documents may be found, and that it should carry out this investigation with the same thoroughness that at present characterises its search amongst British specifications.

In order to help in reducing the gap between the area covered by the search and that contemplated in the legal grounds for invalidation, the latter might be contracted somewhat. For example, it is only in the most academic sense that an invention can be said to be anticipated by an identical invention published twenty-five years ago in German and then forgotten. In fact, invalidation by publication might reasonably be restricted, in the case of foreign specifications, to a period of twenty years, at all events during the experimental stage of the extended search. The effect of publication in periodicals might be restricted to a like period, since their essential subject matter passes in the course of time into text-books. It might even be considered reasonable to rule that prior publication in any language other than English, French or German should not be deemed to invalidate a patent; and, again, it is by no means certain that the present law with regard to prior user gives the fairest balance between the rights of all the parties concerned.

All the points referred to above require careful consideration by the patent lawyers, and if their decision be favourable, the scope of the extended search can be narrowed accordingly without defeating the object of the latter. For our present purpose we shall assume that for all practical ends it will be sufficient to search amongst the patents published in the Dominions, France, Belgium, Germany, the United States, and Switzerland for the preceding twenty years, and to search for a like period all the relevant periodicals at present taken by the Patent Office Library, together with up-to-date text-books. It would also be desirable for the Patent Office examiners to visit works regularly and make notes of standard practice; for apart from the utility of such notes, this plan would keep the outlook of the Office essentially practical and prevent it from becoming too academic.

The advantages to be gained by instituting an extended search are many and important: a few of them may be pointed out here. As has already been argued, the confidence which it would establish would stimulate invention and the development of new manufactures, for it would remove the principal cause of the uncertainty which at present hangs over the patentees of obviously useful and ingenious inventions. There is no need to labour this point, which will readily appeal to manufacturers; but it is important to note the effect of any step of this kind in reviving industry and so helping employment. Then again, at the present time, inventors who wish to protect their inventions abroad have actually to make application in the countries they have selected before they can have any idea of the anticipations which are likely to be cited against them there, and the process of amending to meet the requirements under this head of the American or the German Patent Office is a troublesome and expensive one, which could largely be avoided if the specification had originally been drawn up in the light of full knowledge. Internationally, too, the value of the British patent would be so much enhanced that it would acquire a dominating position in the patent systems of the world. Applications which at present are sent from all parts of the world to Germany or the United States in order to obtain the results of a universal search might then come to Britain, provided that the present standard of thoroughness were maintained intact.

It has been suggested that patents should be granted for the British Empire as a whole, so as to avoid the expense and labour which are incurred when a separate application has to be made in each of the component countries of the Empire. A conference on this subject was held in 1922, but none of the technical staff of the Patent Office was present, and those who advised the chairman on behalf of the mother country were without personal knowledge of the essential work of examination and search. As might be expected in these circumstances, the conference failed to handle successfully the extremely delicate technical question of an Empire search, in which the dignity of the

[1] W. J. Tennant, Presidential Address, Transactions of the Chartered Institute of Patent Agents, 1917–18, vol. 36, p. 41.

Dominions was concerned; in consequence, proposals were adopted which failed to win over the Dominion Governments, and the conference has proved sterile. To some small extent, however, the advantages which would have been gained by the institution of a competently planned Empire patent would be conferred by an extended search; at all events, a patentee who thought of protecting his invention in the Dominions would be able to find out beforehand whether any prior Dominion patent stood in his way.

The extended search would also make possible certain innovations which would cheapen patent litigation in the same way that the institution of Quarter Sessions cheapens criminal procedure. It would make it practicable to empower the Patent Office to deal with certain issues which at present are reserved for the courts, and in particular to grant suitably restricted certificates relating to the validity of patents, having an effect on costs similar to that of the certificates of validity at present granted by the courts. For during the five years 1920–1924, when the Patent Office sealed 83,166 patents and the Comptroller (together with the senior members of the scientific staff who share his judicial duties) gave decisions under the "novelty sections" (7 and 8) of the Patent Acts in 8831 hearings, there were only 7 successful and 3 partly successful appeals against those decisions. Hence no hesitation would be felt in entrusting the Patent Office with wider powers, provided that its Hearing Officers were given access by means of an extended search to the requisite range of facts. The effect of cheapening patent litigation in this way would be to protect poorer inventors against intimidation by the wealthy owners of bad patents, since the latter's bluff depends for its effect on the costliness of patent actions.

The last advantage of an extended search to which we need refer is one that especially concerns research workers. At present there is no very easy way of finding out the precise state of any technical art before embarking on research in connexion with it, and as a result labour is sometimes wasted in repeating work which has been done before, while investigators and inventors are deprived of knowledge which might be of the greatest value in solving for them various problems of design incidental to their main objectives. Now if the Patent Office were to undertake the kind of search we have indicated, it would become an encyclopædic source of information as to the current state of invention in all parts of the world, and the examining staff would become a body of experts able to supply, at short notice, fully documented information as to the methods which have been proposed and the problems that have to be solved in every kind of manufacture. If this information were to be available on payment of a suitable fee *before* the filing of a complete specification, it would enable inventors to put their inventions into the best practicable form.

In this connexion, considerable interest attaches to an article in *La Propriété Industrielle*, May 31, 1925, p. 93, urging the formation of an international classification, so that indexes should have the same sub-headings in all countries. That this in itself is not practicable can best be seen by means of an example. About 450 different varieties of the ordinary tumbler switch are comprised under the appropriate British sub heading, and in order to determine precisely which switches shall and which shall not be included, a rigorous definition is necessary. The definitive heading adopted is:

Electric switches, etc.,
  kinds, etc.,
    snap action switches (springs during a single on or off operation are first strained and then relaxed, to assist or to produce the switching movement) (*including* like snap action switches with gravity action, and snap action details of switches of all types)
      with operating levers and turn members having limited stroke.

In the United States, on the other hand, most tumbler switches would go into the file 200 (67), the heading of which is snappy rather than definitive, namely:

Electricity circuit makers and breakers
  snap
    oscillating contact
      double snap.

It will be clear at a glance that these two files, though they overlap, do not necessarily cover the same ground. Now it sometimes happens that while attending an interview in an overcrowded room an inventor will overhear two examiners wrangling about classification. Let any one who has had this experience picture to himself an attempt to secure mutual agreement, by correspondence between the 100 patent offices of the world, as to (*a*) a definition of what is to be included in the file for tumbler switches, and (*b*) the manner in which that file should be subdivided. However, we may concede the main contention of the article referred to—which is that a universal index would be of the utmost value to the whole world—while at the same time we hold that a single nation must give effect to it.

We have now only to show that the scheme that has been outlined is practicable and that the cost can be met in an acceptable manner. For that purpose an examination of published statistics has been made, and the results will be described and considered in a further article.

Meteoric Astronomy.

Meteors. By Prof. Charles P. Olivier. Pp. xix + 276 + 23 plates. (Baltimore: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1925.) 30*s.* net.

A GREAT part of the most valuable work in recent years on meteoric astronomy has appeared in periodicals published in different countries. As many of these are inaccessible to the average reader, Dr. Olivier's book reviews a number of the most important of the articles appearing in the various journals; the more mathematical parts are segregated, so that the non-mathematical reader can omit these without losing the continuity of the work. The researches of Dr. Olivier and the American Meteor Society for several years on meteoric astronomy, the results of which are included in the book, render it both valuable and interesting, though probably differences of opinion will arise, especially amongst English meteor observers, on some of the conclusions attained.

In the first chapter, "Historical Introduction," we have a brief account of the fall of meteors from the earliest times, the first record being found in the Book of Joshua, chap. x. The author believes that the narrative describes the fall of meteorites rather than hailstones. We may remark, however, that Josephus affirms that thunder and lightning accompanied the phenomenon, which may indicate a fall of hailstones of unusual size, not meteorites. The second chapter describes the methods for observing meteors, including those depending upon photographic work. The mechanical apparatus of Rev. M. Davidson, referred to on p. 14, and stated to have been described in the Journal of the British Astronomical Association, 30, p. 92, is not, however, used for observing meteors, but for determining their real paths from the results of a double observation.

Five chapters are devoted to discussing some of the chief showers, the Leonids, Perseids, Lyrids, Andromedids, Aquarids, and the meteors associated with the Pons-Winnecke comet. In connexion with this first shower and its well-known relation to Tempel's comet, there is an obvious error on p. 40, where it is stated that the orbit has a major axis of 10·34 astronomical units, and the aphelion point is 18 from the sun, but due to the inclination of the plane of the orbit to that of Uranus—about 16°—the meteors could never approach the planet within 5 astronomical units. The *semi* major axis is 10·34, and though the inclination is 16°, yet at the ascending node the comet is about 18·8 from the sun, so that the meteors could come quite close to Saturn at times. It appears as if Dr. Olivier considered the axis major to be inclined at 16°, and then concluded that the comet would be 18 sin 16° from the plane of Saturn's orbit when at aphelion. A very important point is discussed in connexion with the Perseid shower—the shift of the radiant by about 1° in longitude each night. Denning was the first to show that there was this undoubted movement from July until about August 20, but Brédikhine held the view that the radiants observed in July and those probably after August 19 belonged to other streams or were partly chance accordances. The work of the American Meteor Society, however, substantiates the existence of radiants in the positions assigned by Denning to the Perseid radiant from July 28 until August 18, though from July 21 until 27 the data are insufficient to affirm or deny Denning's positions. It seems strange that some European observers should find little or no evidence of a regular motion of the Perseid radiant; English observers have not generally disputed Denning's results.

In Chap. viii. it seems to us that some of Dr. Olivier's criticism is unfair. In 1910 he announced, from observations of the Aquarids, that the connexion between Halley's comet and the η Aquarids was first definitely proved. The radiant is not given in this chapter, but in a previous work, "175 Parabolic Orbits deduced from over 6200 Meteors," published in 1911, the radiants are given on the dates May 4, 6, 11, as 334°·3-4, 337°·7-0°·6, 342°-0°·6 respectively. In the British Association Report for 1874, p. 349, Herschel pointed out the probable connexion, and also in the Monthly Notices of the Royal Astronomical Society, 1876, though Tupman's radiant 325°-2°·5 on May 1-3 was a considerable distance from the theoretical position, 337°-0° on May 4. In the Mon. Not. R.A.S., 1886, Denning states, from his radiant 337°-2°·5, April 30 May 6, ". . . the identity of the two orbits seems placed beyond doubt." The fact that Denning in 1899 was cautious enough to use the expression "probably associated with Halley's Comet," scarcely justifies Dr. Olivier in claiming priority by saying he "definitely proved" the connexion in 1910. Again, on p. 76, in discussing eight radiants, the author submits that Tupman's are the only scientifically observed ones, yet on April 29 Tupman's radiant is 329°-2°, and on May 2-3 it is 325°-2°. Now, as Dr. Olivier holds that the radiant moves about 1° in longitude each day, then Tupman's radiant on April 29 should correspond closely to 332° ± 0° on May 3, a position far from 325°-2° found then. One cannot describe this as one of "the only thoroughly scientifically observed radiants." Indeed, Nos. 4 and 7 by Denning and Corder correspond far more closely with the theoretical position for Halley's comet. In addition to the points raised concerning the Aquarids, this chapter also discusses the meteors of Pons-Winnecke's comet, but the orbits published in the Monthly Notices of the Royal Astronomical Society, 77, 1916, are not

reproduced, as it is thought that the elements might be improved by another treatment and by having certain corrections applied. In the paper referred to, it is thought that the shower extended from May 20 until July 10, though to the present writer this seems very doubtful, and possibly the author may modify his views later when he hopes to make this the subject of a new research.

A considerable amount of discussion takes place on the question of stationary radiants, and a summary of the works of Von Neissel, Tisserand, Turner, Herschel, Brédikhine, Pickering, Plummer and Davidson is given. Dr. Olivier, as is well known, does not believe that stationary radiants as a rule exist, though the researches of those just mentioned show the possibility of such under certain conditions. He admits, however, that approximately stationary radiants near the ecliptic may exist for considerable periods of time, but does not think that the same applies to radiants with high latitudes. Denning was convinced of the existence of stationary radiants before any theoretical justification for them was advanced, and though most of these apply especially to radiants near the ecliptic, there is the possibility of reasons being given for others in the future.

Those possessing elementary mathematical knowledge will find much interesting reading in such subjects as meteor orbits, real heights, perturbations of orbits of streams, formation of meteor streams from comets, etc. The methods of computing orbits are almost identical with those published by Lehmann-Filhès, and many sections of Schieparelli's "Sternschnuppen" are reproduced. The real heights of meteors are found by Schaeberle's method, and an example is given in Chap. xv. It seems to us that it is unnecessarily laborious, and the use of a celestial globe saves much time in this work. Extreme accuracy cannot be attained, especially in finding the height of the beginning of a meteor, as the observers in different places do not usually see its commencement exactly at the same instant. By taking the azimuth and altitude of the beginning and ending on a celestial globe and then using a good map, paths of meteors can be quickly found. Davidson's apparatus described in the Journal of the British Astronomical Association, 30, p. 92, is useful where one of the observers is doubtful of the position of the beginning or ending, but the direction of flight is well known. The instrument itself automatically adjusts the ill-defined position.

Dr. Olivier's work covers practically every branch of meteoric astronomy, and should be extremely useful to those interested in this department. The frequent use of split infinitives may irritate some readers, but this literary defect cannot be said to detract from the scientific value of the book.

Cults and Customs in San Cristoval.

The Threshold of the Pacific: an account of the Social Organisation, Magic, and Religion of the People of San Cristoval in the Solomon Islands. By Dr. C. E. Fox. (The History of Civilisation Series.) Pp. xvi + 379 + 14 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, Inc., 1924.) 18*s.* net.

IT was a more than fortunate chance that threw together the late Dr. W. H. R. Rivers and Dr. Fox while on a voyage to San Cristoval in the *Southern Cross*. It was then that the interest of the latter in anthropology was aroused by Rivers's genealogical investigations. These he regarded at first with some amusement, but as time went on he came to be drawn to the study of the customs and beliefs of the people among whom his work lay as a missionary, with as serious a purpose as that which inspired Rivers himself.

Anthropologists have long been aware that this book was in preparation. The manuscript was in Rivers's hands at the time of his death; but the work of editing was still unfinished, and the task of completing it has devolved upon Prof. Elliot Smith with the assistance of Mr. W. J. Perry. The expectations which had been aroused by the publication of part of Dr. Fox's material in the Journal of the Royal Anthropological Institute are fully justified by the completed work, which, it is no exaggeration to say, will take high rank among the works which record first-hand study of primitive peoples. Dr. Fox writes with the intimate knowledge which comes from careful inquiry as well as long acquaintance with the subject matter; yet he retains a freshness of observation undimmed by familiarity, which serves to carry his reader through a mass of detail without even a suggestion of weariness.

San Cristoval, which lies at the south-eastern end of the Solomons, is divided into several large districts, which differ considerably from one another both in social organisation and in beliefs and custom. Broadly speaking, the west end of the island, which Dr. Fox, extending the strict geographical application of the name, calls Arosi, and Kahua — the eastern end — together with the outlying small islands, differ from the central area Bauro in that they are organised on a totemic basis. Bird clans occur in the west in Arosi, aquatic clans to the east in Kahua, and both are found along the coast of the central part. In the district of Bauro, of which, however, Dr. Fox knows part only, the people of the interior have a dual organisation. Although there are some totemic clans on the coast of this district, as mentioned above, it is clear that the dual organisation underlies them, as might perhaps be expected.

The relationship terms in this district appear to differ from those in any other part of Melanesia in that all the terms and all names have prefixes to distinguish sex, the term used depending upon the sex of the person to which it is applied.

Dr. Fox has paid special attention to the very interesting serpent cult, which has its home in the Bauro district. This cult has many peculiar features, well brought out in the legends connected with the snake which he quotes. Pools, rocks, and waterfalls or large trees are thought to be the abode of *hi'ona*, *higona*, or *figona*, the last being the term Dr. Fox prefers to use throughout. These spirits are never seen; but others, the chief *figona*, had a serpent incarnation only. In this they differ from the *Adaro*, some of whom are ghosts; others, spirits who have never been men. These could take the form of men, dogs, birds, snakes, trees, or clouds. The *figona*, however, seem to be connected with stone worship in addition to their serpent incarnation, for they could take the form of, or withdraw into, stone. Of these serpent incarnations, Dr. Fox regards one known as Agunua as "almost like a supreme spirit" and partaking in some sort of the nature of a divine demiourgos. It would appear that particular *figona* are regarded as local representations of Agunua. Dr. Fox is also inclined to the view that the worship of Agunua was once widespread. On the whole, however, although the legends of Agunua are connected with the creation of certain things, as, *e.g.*, the coming of fire, he scarcely functions in the rôle of creator, and the evidence upon which supremacy is attributed to Agunua appears to be too slender for any positive conclusion.

Dr. Fox has naturally paid considerable attention to the system of relationship—a study for which Rivers's genealogical method has done so much. His results, however, are an illustration both of the strength and weaknesses of that method. He gives a very candid account of the difficulties into which he was led until he discovered the discrepancies introduced into his information by the practice, which Rivers himself noted, of marriage and adoption out of the correct generation. One result of the custom of adoption—amusing enough to us, although it offers nothing incongruous to the native mind- is that a boy may be adopted as a father or a grandfather, and thus stand in either of these relations to those who are his coevals.

"The Threshold of the Pacific" can be considered under two aspects. On one side, Dr. Fox records the results of his observations, and in this his work is deserving of the highest praise. On the other, he seeks to draw ethnological conclusions from his material; and what is really unfortunate, these two aspects are not kept rigorously asunder as they should be. The reader, therefore, may perhaps be pardoned if he has an uneasy feeling that Dr. Fox, in dealing with certain remarkable features in the culture of the San Cristoval, such as the custom of embalming, the modes of burial, the winged serpent belief, etc., has allowed his judgment to be unduly influenced by analogies which undoubtedly may be found in ancient Egypt. He argues that San Cristoval has been peopled by four distinct groups: (1) The Amwea moiety of the dual organisation; (2) the Atawa moiety of that organisation; (3) the Abarihu, part of whom constitute the Araha ruling group; and (4) the people who practise cremation. So far this would seem a not improbable interpretation of the evidence. Dr. Fox, however, goes further and points out that many customs of the Araha exhibit similarities to the cultural complex which has been attributed to the people of the "archaic civilisation" of Indonesia as described by Prof. Elliot Smith, and make strongly for their identification with that hypothetical culture. This, as will be seen from a careful perusal of Dr. Fox's final chapter, has involved him in considerable difficulties, owing to the fact that certain elements of that culture are entirely absent, while others, though present in San Cristoval, do not attach particularly to the Araha. The discrepancy is apparent to Prof. Elliot Smith, who suggests an alternative explanation in his introduction.

It is not proposed to enter here into a discussion of the significance of the similarities of the Araha culture to those of the "archaic civilisation," such as embalming, the burial mounds (called "mastaba" in a diagrammatic illustration of a burial mound, but not in the text) with superimposed dolmens, the winged serpent Hatuibwari, the "double" which goes into a stone statue, and the like. It is well known that Dr. Rivers and Prof. Elliot Smith were both greatly impressed by the evidence collected by Dr. Fox which appeared to point to the culture of ancient Egypt as the nearest analogy. How far Dr. Fox's judgment may have been influenced by that fact it is impossible to estimate, but in the preface it is stated:

"Rivers was virtually Fox's only channel of communication with the ethnological world. Hence it is no matter for surprise that the isolated worker in distant Melanesia was profoundly swayed by Rivers' views, even in some cases when his own evidence came into conflict with them. In respect of these points of difference, it is unfortunate that Dr. Fox is so far away as to make discussion even by letter virtually impracticable. Hence I have felt obliged to leave certain of his statements in a form which I feel sure he would have agreed to modify, had discussion been feasible."

This statement is a little perplexing and might, with advantage, have been made more precise.

X-rays in Research.

La technique des rayons X. Par Dr. A. Dauvillier. (Recueil des Conférences-Rapports de documentation sur la Physique, vol. 10, 2e série. Édité par la société *Journal de Physique*.) Pp. 195. (Paris: Les Presses universitaires de France, 1924.) 22·50 francs.

DURING the first seventeen years after the discovery of X-rays in 1895, the development of apparatus for their production was chiefly influenced by the requirements of medical radiologists. Progress was rapid, and attempts at standardisation were swept away by a flood of ideas, applications, and devices. In the year 1912, however, a great advance in a new and purely physical direction was made possible by the work of Laue. Following this lead and under the inspiration of Rutherford, Moseley, Bragg, de Broglie, Duane, and others, physical research in which X-rays play a conspicuous part has now become of outstanding importance.

Since the immediate questions opened up by this work and by the problems ever before the medical radiologist differ somewhat in their scope and aim, it is not surprising that the appliances evolved in the laboratory for X-ray research work should have come to be very different from those used to-day in medical practice. This evolution is traced out by Dr. Dauvillier in his book. It is essentially a work for those who are already somewhat familiar with the subject, and to whom the general information given at the beginning will serve as a useful reminder of the progressive steps by which our present knowledge has been attained. On p. 35, however, the author is in error in attributing the first X-ray tube with slanting anticathode to Mr. A. A. Campbell Swinton instead of to Sir Herbert Jackson, who, in fact, actually made it with his own hands.

After referring to the construction of "gas" tubes and their mode of regulation, we reach the section of the work dealing with the hot cathode device due to Lilienfeld and Coolidge. It is here that the value of the book is most apparent, for the author has brought together much valuable information which was previously scattered, and therefore only accessible with difficulty. The applications of the hot cathode idea are considered in detail, and the modification of the usual radiographic type of tube to suit the special requirements of the laboratory is explained and illustrated. We thus have the advantage of studying the design of the modern tubes employed in X-ray spectroscopy, with full notes of the difficulties to be met with in their use and the means of overcoming them, written by one who is himself an accomplished experimenter. Incidentally, since most of these tubes require to be continually exhausted of gas while in action, the author refers to the latest pumping methods, and gives an interesting description of a tube with liquid anticathode and also of one with a gaseous target.

The medical radiologist is, of course, gaining valuable data from the purely physical work on absorption and scattering of X-rays under various conditions, as well as from the study of the energy distribution in X-ray spectra, and he is also beginning to realise the desirability of utilising for his work a type of electrical plant that will provide a constant current at a pressure of, say, 200,000 volts. Apparatus of this kind was first set up in the United States for careful physical work on X-ray spectra, and a modification of the plan then adopted, and due largely to Dr. Dauvillier himself, is now being developed in France. Germany, too, is actively manufacturing constant current high voltage plant for X-ray work. The author has therefore wisely devoted a whole chapter to this important matter.

With regard to protection, there is no mention of the recommendations of the X-ray and Radium Protection Committee which were issued in 1921, and the author is perhaps too definite (p. 114) in referring to what he considers a safe minimum radiation intensity. It is felt by many that we are not yet quite sure as to the biological effects of exposure to a very feeble radiation over long periods of time continuously.

The book deals towards the end with the vexed question of X-ray measurement, a subject to which Dr. Dauvillier has himself made some notable contributions. Finally, there are brief references to medical, industrial, or other applications of X-rays.

We recommend this work to all physicists who are engaged upon researches in which a technical knowledge of the subject is indispensable. It is clearly written, well arranged, and fully illustrated. Its use would be still further enhanced, however, by the provision of a more adequate index, or at least the revision of the existing "table des matières," where in several instances the page numbers do not agree with the references in the text. C. E. S. P.

The New Principia.

Principia Mathematica. By Prof. Alfred North Whitehead and Bertrand Russell. Second edition. Vol. 1. Pp. xlvi + 674. (Cambridge: At the University Press, 1925.) 42*s*. net.

THE great achievement of the authors of "Principia Mathematica" is to have deduced mathematics by strict symbolic reasoning from a small number of logical propositions. This was previously attempted

by Frege in his "Grundgesetze der Arithmetik," but without success. For his axioms, like those of most logicians, were found to imply contradictory consequences, such as the famous paradoxes of the theory of aggregates. In particular, both the thesis and antithesis of the well-known contradiction about the class of all classes not members of themselves could easily be deduced from Frege's primitive propositions.

To escape this difficulty, Prof. Whitehead and Mr. Russell invented the theory of types, by which both the thesis and antithesis of such contradictions were ruled out as strictly nonsensical. By means of this theory they succeeded in constructing a system adequate for the deduction of mathematics and, apparently at least, free from contradiction. But this system was not entirely satisfactory: apart from the reductions in the number of primitive ideas and propositions, which have been effected by Sheffer and Nicod, the principal need for improvement was in connexion with the "Axiom of Reducibility." This axiom was introduced to justify a common form of mathematical reasoning, which would otherwise have been invalidated by the theory of types.

Unfortunately, the axiom is by no means obviously true, and was only put forward because no less objectionable assumption could be found which would justify the ordinary theory of real numbers and Dedekind section. This unsatisfactory state of things led Weyl and others to reject the theory of real numbers as groundless, and to try to construct a truncated analysis without using Dedekind section. Consequently the main interest of this new edition of "Principia Mathematica" lies in its treatment of the axiom of reducibility.

The authors have left the text of the work unaltered, to avoid the enormous labour of changing the references throughout three volumes, but have added a new introduction and appendices. The introduction contains a much simplified exposition of the theory of types, and the outlines of a new theory in which the axiom of reducibility is replaced by a new assumption suggested in the first place by Wittgenstein for philosophical reasons. This new assumption is entirely unobjectionable, because it is of such a form that it could be made a mere matter of definition. Unfortunately, it is not nearly so fertile as the axiom of reducibility, and whole branches of mathematics, such as the theories of infinite cardinals and ordinals, of mathematical induction, and of real numbers and Dedekindian series require a new treatment.

The authors have only succeeded with this new treatment in one of the important cases, namely, mathematical induction, of which a full account is given in one of the appendices; there with great ingenuity and arguments involving functions of the fifth order, all the usual theorems are established without using the axiom of reducibility. On the other hand, the authors confess that "There is, however, so far as we can discover, no way by which our present primitive propositions can be made adequate to Dedekindian and well-ordered relations. . . . It might be possible to sacrifice infinite well-ordered series to logical rigour, but the theory of real numbers is an integral part of ordinary mathematics, and can hardly be the object of a reasonable doubt. We are therefore justified in supposing that some logical axiom which is true will justify it. The axiom required may be more restricted than the axiom of reducibility, but, if so, it remains to be discovered." It seems, however, possible that the whole trouble really arises from defective philosophical analysis, and that if the theory of types were suitably modified all need for any such axiom would disappear. But this possibility is not considered by the authors, in spite of the fact that the work of Wittgenstein, for which Mr. Russell has expressed such admiration, appears to point in that direction.

The three new appendices deal with the "Extension of the Theory of Deduction," of which a new account is given based on the work of Sheffer and Nicod, with the new theory of mathematical induction, and with the new and paradoxical philosophical assumption that all functions of propositions are truth-functions, which is defended by various subtle distinctions. We may regret the absence of any reference to the question of identity, or answer to the criticisms of Wittgenstein, "from which," Mr. Russell wrote in his introduction to "Tractatus Logico-Philosophicus," "there seems no escape." A useful addition has been made in the form of an index of definitions.

Although it still achieves no final solution of the difficulties, "Principia Mathematica" is likely to remain for many years the standard work on the subject, and its republication is a most important event.

Oats.

Oats: their Varieties and Characteristics; a Practical Handbook for Farmers, Seedsmen, and Students. By Herbert Hunter. (Practical Farming Series.) Pp. 131. (London: Ernest Benn, Ltd., 1924.) 8*s.* 6*d.* net.

IT is a matter of some significance that this book is addressed to the seedsman equally with the farmer and student, for in the past it has not been sufficiently realised to what a large extent successful crop production is determined by the suitability, genuineness, and quality of the seed employed. The manner in which Mr. Hunter has treated his subject should of itself be

valuable to the seedsman and to the farmer, as showing that the problems of both are in many details essentially the same, and are only to be solved to the mutual advantage of the two interests by painstaking and accurate methods of research.

The origin of the cultivated oat is briefly discussed, and the author does not accept it as definitely proved that the varieties of *Avena Sativa* have originated from the wild oat (*Avena Fatua*), although he would seem to regard the appearance of "false wild oats" amongst the cultivated varieties as an indication of "degeneration" towards the wild type. In this connexion it may be remarked that false wild oats occur equally amongst the oldest varieties like Welsh sprig and the newest like Victory, and in fact probably occur amongst all the cultivated varieties of *Avena Sativa*. The botanical characters of the oat, particularly such as are valuable for discriminating between one variety and another, are adequately dealt with in simple language.

The body of the book is devoted to a description and classification of the chief varieties of oats, and the economic value of each variety is briefly discussed, while in a concluding paragraph the reader is reminded that varieties with a distinctly early ripening habit are not recommended for normally early districts. The descriptions of the varieties have been based on material grown under the author's supervision, and he has used the various characters of panicle, grain, straw, growth habit, and time to reach maturity in a manner very similar to that of Marquand and others, who have also critically studied the varieties of oats.

Distinction is made between *Avena Sativa Orientalis* and *Avena Sativa* proper; the latter is divided into the following five sub-groups, which can be easily and satisfactorily differentiated: "winter hardy," "semi-winter hardy," "potato," "abundance," and "early ripening." Keys are given to the different varieties in relation to the groups and to the varieties of *Avena Sativa Orientalis*. The value of this section of the book would have been enhanced had the author dealt with the question of synonyms, and since in practice the greatest difficulties occur in the recognition of the varieties of the "abundance" division and between some of the newer of the Tartar-like varieties, it is to be hoped that in a subsequent edition of the book such varieties will be described in greater detail.

A comparatively long chapter is devoted to the chemical composition of the oat grain, in which the researches of Brenchley, Brenchley and Hall, Berry and others are faithfully discussed. Although valuable to the student, this chapter is likely to prove wearisome to the seedsman and the farmer. Excellent chapters on seed selection and the production of pure seed conclude the book. The text is supported by eighteen extremely good figures, which are very typical of the varieties they represent.

No mention is made of the diseases of oats, although the reaction of varieties to disease must at the present time be regarded as one of their most important characters.

Output of Scientific Papers.

Catalogue of Scientific Papers. Compiled by the Royal Society of London. Fourth series (1884–1900). Vol. 19: T—Z. Pp. vi+877. (Cambridge: At the University Press, 1925.) 168s. net.

WITH the publication of the volume before us, the indexing of the scientific papers of the nineteenth century under their authors' names has been successfully brought to a close. It is unnecessary to reiterate the high opinion which we have previously expressed of the practical utility of this monumental undertaking and of the high standard of accuracy maintained by its successive editors and their staffs. The "Catalogue of Scientific Papers" is an indispensable tool for the research student and historian of science alike.

Its value for statistical purposes, however, has not been equally recognised. No statistics were published in the prefaces to the first three Series and their Supplement; but a rough estimate made from a calculation of the average number of entries on a page gives the following results:

Period.	No. of Author Entries.	Yearly Average.
1800–63	195,120	3,097
1864–73	80,070	8,007
1874–83	100,750	10,075
Supplement	26,560	320
1884–1900	384,478	22,616

After 1900 the work of the Royal Society was continued on a greatly extended scale in the International Catalogue of Scientific Literature. Approximate figures of the output of this body were published by the present writer in a work reviewed in NATURE on October 20, 1923, pp. 585-6. The figures are as follows:

Year.	No. of Author Entries.	Year.	No. of Author Entries.
1901	43,440	1908	75,034
1902	49,896	1909	70,030
1903	49,264	1910	85,519
1904	50,741	1911	74,773
1905	73,034	1912	69,323
1906	74,877	1913	62,799
1907	74,327		

These figures suggest a curious parallelism between the movements in western science and civilisation in the first thirteen years of the twentieth century. Coupling the two sets of statistics it will be seen that the output of scientific papers showed continuous progress from

1800 until 1910—the rate of progress accelerating rapidly between 1884 and 1910—the peak year of scientific activity.

These figures, imperfect as the basis for their compilation admittedly is, deserve the attention of statisticians, and it is to be hoped that in future consolidated author indexes published by the Royal Society, the statistical value of the data contained therein will be kept in view. E. W. H.

Our Bookshelf.

Living Organisms: an Account of their Origin and Evolution. By Prof. Edwin S. Goodrich. Pp. 200. (Oxford: Clarendon Press; London: Oxford University Press, 1924.) 6*s.* net.

PROF. GOODRICH has written a wholly excellent introduction to biology. The opening chapters deal with the elementary principles of biophysics and biochemistry, and with the nature of life, reproduction and death. The remainder of the book is taken up with an exposition of the facts and theories of evolution, and the author has here given a very clear account of the present state of knowledge of heredity and allied problems, and of the latest advances which have been made in this field, both from the experimental and cytological aspects. The book is intended mainly for the general reader, and the author has therefore been meticulously careful to define exactly the terms which he uses. There can be no doubt at all in the mind of the reader as to what he means by such terms, for example, as inheritance, variation and character. This clarity of meaning is particularly emphasised in his treatment of the vexed question of the inheritance or not of so-called acquired characters. Reiterating the view of Sir Ray Lankester that the characters of organisms are in the nature of responses to environmental stimuli acting on a complex of germinal factors and must be made anew at every generation, he advocates, with the late Prof. Sedgwick, that the popular distinction between acquired and not acquired characters is illusory, and pleads for the abandonment of the expression "acquired" character altogether.

There is much to be said in favour of this view. The true Lamarckian theory of evolution demands the production of changes in the germinal factors of inheritance as the result of environmental stimuli, and of this there is at present no convincing evidence. At the present time, when the Lamarckian position is receiving so much attention at the hands of scientific workers, it is particularly desirable that the general reader should have before him a clear and simple explanation of the situation which will enable him to understand the problem and appreciate the nature of the evidence brought forward for or against the theory. The student of science, too, will find much that is helpful in this excellent little book.

The New Decalogue of Science. By Edward Albert Wiggam. Pp. 287. (London and Toronto: J. M. Dent and Sons, Ltd., n.d.) 7*s.* 6*d.* net.

SCIENCE has its natural enemies—it has also its unnatural friends. Nothing could be more distasteful to a genuine student than this hymn to science—a sort of Main Street Nietzscheanism. The writer assures us that it is "no extravagant assumption, but the surest deduction from science itself, that science only can supply mankind with the true technology of the will of God." This Will is brought down to us in the New Decalogue, written down mainly for the statesman who, we are told, decides "who shall survive and who shall perish in the struggle for existence," who "in a real sense . . . determines the very trend of human evolution." The belief in Divine Will, in science and in statesmanship leads to such views as the following: "that the advanced races are going backward," "that medicine, hygiene and sanitation will weaken the human race," "that morals, education, art and religion will not improve the human race"—all these are chapter headings.

We are ready to admit that "pauperism is as distinctly inherited as the capacity to create wealth" or perhaps even more so. But the author's proof sounds like insufficient induction: "I know one family in which in a hundred and fifty years not a single member has saved up five hundred dollars." We are at first shocked to hear that "Vice and disease purify a race. Wickedness, folly, sin, are all nature's methods of racial purgation." But we acquiesce when we are told that "the old Hebrew statesmen saw this principle of nature as clear as day. They constantly said in substance: 'The children of the wicked are cut off,' 'The fool shall perish by his own folly,' . . . 'The wages of sin is death.'" All this apparently shows that modern biology could be taught from the Old Testament.

The worst of it is that the book, written in a thoroughly unscientific spirit, yet advocates many good things such as eugenics, biometric research, application of biological conclusions to sociology and politics—all of which are bound to suffer from such advocacy. No wonder that a professional, though not very dangerous, enemy of science, Mr. Bernard Shaw, has easy play with the book in a letter which the author has proudly appended to the volume. It is both unpleasant and difficult to safeguard the interests of science from such benevolent and enthusiastic propaganda of its self-appointed apostles. B. M.

Adventures of Exploration. By Sir John Scott Keltie and Samuel Carter Gilmour. Book 1: Finding the Continents. Pp. iv+128+4 plates. 1*s.* 6*d.* Book 2: Central and South America. Pp. iv+156+4 plates. 1*s.* 8*d.* Book 3: Asia. Pp. iv+164. 1*s.* 10*d.* (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., n.d.)

"TRAVAILE," said Bacon, "is a Part of Education. . . . Let Diaries, therefore, be brought in use." The authors of these books on adventures of exploration have ransacked the diaries of the world's greatest travellers to describe in simple language some of the outstanding expeditions by which the world has been discovered by and for Europeans. The stories range in "Finding the Continents" from the epoch-marking voyages of Columbus to those of Barents and Cook in the northern and southern seas. South America forms the scene of exploits from Cortes in Mexico and Pizarro in Peru to Fitzgerald's magnificent failure on the height of Aconcagua and Roosevelt's voyage on the River of Doubt. In Asia, between the romantic

journeys of Marco Polo and the tragic struggles to conquer Everest, there are a dozen stories of adventure and daring, not merely to lay bare the secrets of Nature, but to inquire into the habits and the life of man. De Lesseps in Siberia, Manning at Lhasa, Layard in Persia, Garnier on the Mekong, Burnaby at Khiva, and Doughty in Arabia, these are some of the adventurous travels sketched lightly and interestingly in this book. Useful sketch maps, recalling in their style and ornament the old maps of travel, make the narratives of special value and justify the authors' hope that these "supplementary readers" will quicken interest in geography by stories of adventurous travel. The selection has been well made, and the narratives not only afford an idea of some of the main steps by which knowledge has been gained, both of the world as a whole and of the separate continents other than Europe, but show also how many place names owe their origin to explorers, and recall incidents of exploration.

A Brief History of Civilization. By John S. Hoyland. Pp. 288. (London: Oxford University Press, 1925.) 3*s.* 6*d.* net.

WE ought to welcome the efforts, which are now becoming so frequent, to present the history of mankind as one, a progressive thing, culminating in a unity of which the League of Nations is the symbol and organ. Mr. Hoyland's little book is the best we have seen at the size and price, and it is published by the Oxford Press, which is distinguishing itself for works tending in that direction. Kant's prediction of the course of history-writing, made in 1782, is beginning to be realised in our day; that part and type of history is being most studied and commemorated which tends to the general good of mankind. Mr. Hoyland is possessed by this idea, and consequently gives us an appreciative account of China and a full, though discriminating, judgment of the contributions of Greece and Rome. There is also more, though not so adequate, allusion to the rôle of science in history than would be found in most books of earlier date.

The less effective part of the book is the last third, where the facts are so multitudinous as to occasion more compression and generalisation, and we think the general treatment suffers by the emphasis on the evils of nationalism and the discussion of problems raised by the growth of internationalism. It is really better, from the author's own point of view, to describe sympathetically what the various nations have done towards the common end than to dilate on the underlying problem. In practice this means more space *all through* to the triumphs of science, invention, and various forms of international association, rather than relegating all these topics together to one concluding chapter. But the book on the whole is sound and useful, and a great advance on anything of the kind yet attempted, and it is admirably illustrated and produced. F. S. MARVIN.

Essentials of Scientific Method. By Prof. A. Wolf. Pp. 160. (London: G. Allen and Unwin, Ltd., 1925.) 5*s.* 6*d.* net.

PROF. WOLF'S delightful book should be in the hands of every teacher of science. It is written with an admirable lucidity, and treats its subject in such a plain and straightforward way that no previous knowledge of logic or psychology is necessary for its comprehension. Most science teachers are interested in the philosophy of scientific method, but comparatively few have the leisure to make a thorough study of it. To the busy majority Dr. Wolf's book will prove of great interest and value, and for the others it will provide a convenient epitome.

The author does not go deeply into the fundamental question whether the world which science describes is a world of reality, and in this he is wise. He confines himself to a description of the methods actually employed by science to obtain those results which are familiar to every one. His treatment of "Order in Nature and Laws of Nature" is a particularly skilful exhibition of skating upon thin ice, but there can be little criticism of the position he adopts. "On the whole," he says, "experience has shown that there is some order in nature, even if nature be not orderly through and through." We cannot agree with him, however, when he says (p. 126) that it is not very likely that Boyle's Law and similar generalisations would be assumed to hold good of newly discovered substances without experimental verification. E. J. H.

La matière vivante: organisations et différenciations, origines de la vie, colloïdes et mitochondries. Par Prof. J. Kunstler et F. Prévost. Pp. 253. (Paris: Masson et Cie, 1924.) 18 francs.

THIS rather curious booklet contains an exposition of the authors' views on the structure of protoplasm. Their main contention is that the structural organisation of protoplasm is as important for the processes of life as is its chemical composition. With this few would disagree, especially after the remarkable experiments of Warburg and others upon the rôle of structure in such fundamental activities as respiration.

The book, however, is uncritical and one-sided. All sorts of structures are lumped together, and the work of others is very unequally treated. Little attention is paid to the views of such authorities as E. B. Wilson, R. Chambers, and others, that the visible structure of protoplasm may readily change in accordance with change of physiological state, nor is there any proper discussion of modern work on micro-dissection or physiological cytology.

The work will be of some interest to the specialist, but can scarcely be recommended to the general biological reader.

The Annual Register: a Review of Public Events at Home and Abroad for the Year 1924. Edited by Dr. M. Epstein. (New Series.) Pp. xv + 326 + 171. (London: Longmans, Green and Co., 1925.) 30*s.* net.

THIS admirable survey of the year's history is planned on the lines which have been long familiar. An account of British history, followed by foreign and imperial history arranged under the headings of the various states, occupies two-thirds of the volume. Then come a tabular chronology of events, a survey of literature, art, music, science, law and finance, and obituary notices of the year. These surveys are necessarily very condensed, but lack neither lucidity nor critical estimates of the field of survey. Some of the more important treaties and agreements of the year are printed in full.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Ether-Drift and Relativity.

DR. SILBERSTEIN'S deductions from Prof. D. C. Miller's surprising optical experiments, as contained in NATURE for May 23, are equivalent to stating that there is a drift of the ether with respect to the earth, and the horizontal component velocity of this drift is very small at ordinary ground level but rapidly increases with height z, so that it reaches about 10 km./sec. at the height of Mt. Wilson (1·731 km.); whence $\delta u/\delta z = 5{\cdot}7$ sec.$^{-1}$ approximately for the intermediate zone. The mere existence of this measurable drift would be in conflict with the very foundations of relativity.

Objection against these conclusions is raised in NATURE for June 6 by Prof. Eddington, who remarks that the described ether-flow being strongly rotational, it could not satisfy Stokes's condition for non-influence on astronomical aberration; and the consequences would be in disagreement with the measurements made every day in astronomical observatories.

I think that from the mathematical point of view this objection may be removed on remarking that it takes into account only the horizontal component of the drift. If x is the co-ordinate in the direction of this component, and w is the vertical component of the drift, the full expression for the *curl* of the drift-velocity in the xz plane is $\delta u/\delta z - \delta w/\delta x$, and therefore the flow might be everywhere irrotational, even with a high value of the term $\delta u/\delta z$, provided there is a corresponding $\delta w/\delta x$ to match it.

It is true that in the light of the first theory given by Stokes and expressed by Lorentz in his standard book "The Theory of Electrons," Ch. v., 147-148, the irrotationality of the flow would not be sufficient to destroy the influence on aberration, and certain additional conditions ought to be satisfied by the velocities of the ether near the stars and near the earth. But a careful consideration shows that the aberrational effects as observed by astronomers do not depend on the differences between the directions on the wave normals at the origin and the end of the light-ray, as considered in the above theory, but exclusively on the paths of the light-rays themselves. Therefore, the right theory to be employed is the second one given by Stokes with Challis's corrections, and further developed by Larmor in "Aether and Matter," iii. 22, according to which the irrotationality is the only condition required.

In the light of this conclusion, Planck-Silberstein's hypothesis of an irrotational and extremely compressible ether with a negligible drift at ground level might be sufficient to secure agreement with all standard astronomical measurements at all heights, and with terrestrial geodesic observations (absence of geodesic aberrations); but it requires a compression so high as 60,000 at sea-level; and it further requires that the "grip" of the earth on the ether be purely gravitational, according to Silberstein's vivid expression, because Michelson and Gale's experiment has shown that the ether does not follow the daily rotation of the earth. Even a broader theory might be adopted, since the latter experiment, performed inside an iron pipe, shows that the pushing forward of the ether by the earth, if any, is not due to impenetrability or to adhesion to material surface, and therefore Planck's condition that the vertical flow of the ether at ground level be zero may be discarded.

Three points of difficulty are, however, to be considered, namely:

(1) To show that an irrotational distribution of flow can be effectively mapped out, which numerically agrees with the various values of the horizontal velocity found by Prof. Miller at different heights and times.

(2) To explain why, since the grip on the ether is not due to material surface adherence, its horizontal drift is reduced so nicely to zero at about sea-level and not to any other level whatever.

(3) Since $\delta w/\delta x$ requires to be so high as 5 or 6 sec.$^{-1}$, it follows that if the vertical drift be zero at a certain point, it will be about 500 km./sec. at some point at 100 km. distance at the same level. If there is a vertical ether flow of this magnitude, it will be revealed at once by very common electromagnetic experiments or by a quite unrefined repetition of Prof. Miller's experiment in a vertical direction.

In the present condition of things it will be advisable not to draw any conclusion from Prof. Miller's experiments until results of further experiments are available, and until, finally, we are able to examine whether some unknown phenomenon has affected the results.

GIOVANNI GIORGI.
University of Rome
(Regia Scuola d' Ingegneria),
June 29.

P.S.—Since writing the above, I have seen Prof. Miller's article which appears in the issue of NATURE for July 11, giving further and very interesting particulars on his experiments. My conclusions are not modified by it. G. G.

Experimental Study of the "Soaring" of Albatrosses.

THE letter by M. Idrac, under the above title, in NATURE of April 11, was one constituting an earnestly important contribution to the fascinating subject of soaring flight; for it is undoubtedly the case, that so far as the sea considerably impedes the lower strata of the wind, an albatross must be able to soar in the manner recorded. The methods of energetics (having regard to the internal energy of the air) may certainly be employed to indicate this, but the less often used acceleration-of-headway method may be employed as a simple, precise, kinematical alternative. For example, when the bird in its relationship to the enveloping air is gliding upwards at an angle α degrees above the horizontal, at a headway of V feet per second, and against a wind from the north, it is tending to lose headway gravitationally at the rate of $g \sin \alpha$ feet per second per second. It may also be regarded as tending to lose headway frictionally, at the rate of g/n feet per second per second, where n is the ordinary lift/drag ratio. On the other hand, if the higher strata of the wind are travelling faster southwards, to the extent of v feet per second for each foot of vertical height, the bird tends to gain headway at the rate of $Vv \sin \alpha \cos \alpha$ feet per second per second, because $v \cos \alpha$ feet per second is the component of increment of wind velocity head on to the bird, per foot change of height, and $V \sin \alpha$ feet per second is the vertical rate of gain of height. Accordingly, for the bird to continue gliding upwards at steady or increasing headway it simply needs to have

$$Vv \sin \alpha \cos \alpha - g \sin \alpha - g/n < 0, \quad . \quad . \quad (1)$$

that is to say, not negative.

From (1) is deducible for calculation,

$$\frac{g}{V}\left(\sec\alpha+\frac{1}{n}\operatorname{cosec}2\alpha\right). \quad . \quad (2)$$

For every angle α at which the bird may choose to steer upwards there is therefore a certain v of the air which will keep the bird gliding without losing headway; but the particular angle α that allows v to have its minimum serviceable value, and in which therefore we are most interested, is ascertainable from (1) or (2) to be governed by the condition that

$$(2\operatorname{cosec}\alpha)/(\sec 2\alpha+1)=n, \quad . \quad . \quad (3)$$

quite independently of what the V of the bird may be.

For the following values of n—

0, 1, 5, 10, 15, 20, 30, 50, ∞,

formula (3) determines these corresponding approximate values of α,

45°, 38°, 28°, 24°, 21°, 20°, 17°, 15°, 0°,

or about twenty degrees for the whole range of values of n usually found in practice. In particular, the birds with $n=18$, observed by M. Idrac, have the comparatively steep angle of 20·4 degrees as the best angle α up which they should prefer to steer in this kind of soaring. Inserting therefore this value of α in formula (2), and also inserting the observed value of 72 feet per second for the value of V, it transpires that those birds may soar steadily upwards against the wind when v, the increment of wind velocity per foot of height, is not less than 0·552 feet per second. If v exceeds this the bird will not merely not lose headway, but actually be able to gain headway, even for a range of upward angles α a little greater and a little less than the best angle of 20·4 degrees of this case. This width of range of angles, less than and greater than the best, increases when v is increased, according to values deducible from formula (1) or formula (2).

It is notable that in formula (2), v is inversely proportional to V, quite confirming the observations made, that the birds of greater headway more easily perform this kind of soaring; but at very great headways and for the whole soaring manœuvre this rule tends to reverse, when the energy-wasting reactions of sharp turns, up and down as well as sideways, with large birds and especially with large aeroplane appliances, are taken into account. As regards rules, this seems the place to recall that the best angle of ascent has no connexion with V but only with n, and that the best angle of ascent is not very sensitive to ordinary differences in even n, nearly always wanting to be about twenty degrees—a simple rule for bird or man.

For the return or southward journey we may use the same expression (1), but with the sign of the gravitational middle term made positive, and with the angle α measured downwards from the horizontal; and we can insert the minimum value of v just found and supposed to be prevailing, that is, 0·552 feet per second. The angle α so determined for a steady glide for the bird of headway 72 feet per second is then a mere 1·4 degrees downwards from the horizontal. Truly it is downwards and not upwards, but as it is only about half the ordinary gliding angle, the bird evidently obtains some soaring assistance even on the return journey.

The whole indicated procedure of the bird, then, as viewed from the east, and entirely corresponding to observations made, is to glide to the right and steeply upwards from the surface of the sea, until it reaches the height where v ceases to be so great as 0·552 feet per second. If this height is 100 feet, the bird takes 100/(72 sin 20·4°), or about 4·0 seconds to arrive. There the bird wheels round and takes a long flat glide to the left, of duration 100/(72 sin 1·4°), or 56 seconds, down to the surface of the sea, where it again wheels round and proceeds to repeat the whole cyclic process every 60 seconds. But it is to be noticed that each brief ascent of the bird takes place much farther down-wind than the last ascent, so that the bird may drift rapidly southward through the seascape; even nearly as rapidly as the headway of the bird plus the velocity of the wind at a height of about 50 feet, and that may easily be so great a total as 60 to 70 miles an hour. It becomes, therefore, a debatable point to consider how much or how little the bird may depend on *this* particular cycle of soaring, and yet preserve its position in the seascape, outside a headland or bay or close to a slow ship, so well as it sometimes does.

But the fact which just for an instant can occasion a little surprise, is that the bird need not turn round, but may continue northward against the wind. It may not soar higher, and it cannot even continue to glide level without losing headway, but it may, and indeed must direct itself steeply downwards to proceed at steady headway. The negative value of α that satisfies formula (1) is 42 degrees, and at that slope the bird may descend 100 feet in 100/(72 sin 42°), or 2·1 seconds, after previously taking the 4·0 seconds to ascend at the slope of 20·4 degrees. The procedure of the bird is now to execute a series of deep hollow swoops, northwards against the wind, pointing down at 42 degrees for 2·1 seconds and then up at 20·4 degrees for 4·0 seconds, the whole swoop being then repeated every 6·1 seconds. The progress northwards is at the rate of (2·1 × 72 cos 42° + 4·0 × 72 cos 20·4°)/6·1, or 62·5 feet per second, or 43 miles an hour relatively to the air at the mean 50-foot level; so that to the extent that the wind at the 50-foot level is less than 43 miles an hour the bird can actually advance northwards through the seascape, against the wind. When it has so progressed for a mile or so in a number of swoops, *then* it may wheel round and take the pleasant, long flat glide with the wind, and continually repeat such a grand combination process in a way to keep to one locality in the seascape.

Nevertheless, the above presents the case as a pure case, artificially arranged so, and of necessity, for the purposes of calculation and abstract reasoning. The strata of the actual wind must refuse to shear smoothly over one another without breaking into a turbulent state, and especially into small and large eddies rotating around horizontal cross-wind axes. These turbulences offer other opportunities of soaring, that are also to be expounded in the form of pure, abstract cases; and so great an artist as the albatross may not be wholly negligent of, and unthankful for, such opportunities, although *stratified structure-gust soaring* (if that name be allowed) may be the bird's great favourite. The name "stratified structure-gust soaring" may be understood to refer to the fact of the wind being supposed to be stratified in its velocity structure, and also to the fact of the bird soaring by a head gust that is present, not as an actual acceleration of the air particles themselves, but by reason of the bird judiciously crossing the velocity structure of the air in such manner as to develop for itself a useful "structure-gust" effect. This term was similarly proposed in 1913, in the book "Aeroplanes in Gusts and Soaring Flight," by the present writer.

Now, so far as an albatross can soar in the way observed and described, there would seem little reason why a small and fast aeroplane, manned by an interested pilot, should not immediately soar to some extent in a like manner, by facing the wind blowing

over the sea or a large lake, or possibly over a large flat plain, and quickly swooping down and up close to the surface—pointing down at about 40 degrees and then up at about 20 degrees, or at about half these angles if the propeller is allowed to be of some assistance. At suitable intervals it may take the long flat glide with the wind. In any case, however, independently of soaring, aviators may have need to consider that in starting off against the wind it may be convenient to point up at an angle approaching 20 degrees, and so endeavour to continue; and in the event of being compelled to point their aeroplanes down they may have need to be prepared for the lowest strata of the air near the sea seeming to refuse proper support. Indeed, some experiences of this character already seem to confirm M. Idrac's observations of the wind near the surface of the sea.

S. L. WALKDEN.

London, June 8.

Science and Intellectual Freedom.

IT is with considerable amusement that I have read the collection of opinions published in NATURE upon the recent action of the State of Tennessee in forbidding the teaching of what we believe to be the established facts of human evolution in schools supported by public funds. There is an admirable undertone of contempt and condemnation in most of these contributions and a scorn that spreads at moments from Tennessee and Oklahoma to things American in general. Yet the British Government is at the present time in an almost parallel position to the Government of the benighted State of Tennessee in regard to a closely similar body of knowledge. At present if a medical officer of health or a health visitor in public employment gives information about contraceptives to a patient publicly paid for, he or she is liable to dismissal, and several cases of dismissal have occurred. The Minister of Health in both the previous and the present governments has refused to allow these officials the freedom, at their discretion and with all circumstances of privacy, to give this sort of information to adults asking for it from them. There is no question of propaganda here or of forcing this kind of knowledge upon those unwilling to receive it. But British adults of the poorer classes wishing to know this much about their own bodies and to have this much of control over them, cannot get it in a private, seemly and proper manner from their publicly supplied and duly qualified medical advisers, but must resort to the one or two overworked privately supported clinics that exist, or to furtive expedients, to quacks and underhand and dubious sources of information. This is mainly a concession made by these successive Ministers of Health to the Roman Catholic vote. They plead that taxpayers of that persuasion might object to their money going to supply such knowledge to people with different views. But that is precisely the argument of the Tennessee legislators. They plead that a respectable body of old-fashioned Christians regard the doctrine of human evolution as a dangerous and sinful heresy and that therefore they may object quite reasonably to their money being spent upon its diffusion.

In all these matters I am for open and accessible knowledge and free and frank discussion everywhere, in Britain as in Tennessee, but I submit that the *élite* of British science have no case against the State of Tennessee until they have done something to put our own house in order. Perhaps later you will give us another Supplement of a rather wider scope and raise the whole problem of intellectual freedom in relation to these modern publicly endowed systems of education in which the teacher is at any time liable to the irruptions and direction of the government and the politician. The bulk of our educational organisation at every stage and much of current research could not exist without State support and subsidies, and the riddle of receiving maintenance without sacrificing freedom is a very fine and subtle one, which is not disposed of by damning Tennessee.

H. G. WELLS.

Easton Glebe, Dunmow,
Essex, July 16.

On the Presence of a Perennial Mycelium in *Pseudoperonospora Humuli* (Miyabe & Takah.) Wils.

IN a recently published article (*Annals of Applied Biology*, 12, p. 121, 1925) we have given a description of the downy mildew of the hop (*Pseudoperonospora Humuli*), a disease until recently unknown in England or in Europe, but now beginning to cause considerable damage in Kentish hop-gardens. The object of this note is to record certain new facts, of scientific and economic importance, which have been lately discovered in the life-history of this fungus.

The occurrence of diseased, stunted, "spike"-like shoots arising from the root-stock of the hop so early as April led to a search being made for mycelium in the perennial underground parts. Examining during May one- and two-year-old diseased nursery "sets," by means of hand-sections stained with azo-blue, the existence of mycelium was ascertained in the pith and cortex of one-year-old portions of the "crown." The mycelium was not traced lower than this, but there is a possibility that it may be even deeper-seated. The presence of a hibernating mycelium in certain members of the Peronosporaceæ has already been recorded; in the case of the beet mildew (*Peronospora Schachtii*), by Kuhn, in 1873; and in the onion mildew (*P. Schleideni*), by Dr. P. A. Murphy, in 1921 (NATURE, 108, Nov. 3, p. 304).

The alarming feature of the outbreaks of the hop downy mildew which are now taking place for the first time in hop-gardens in England is their epidemic nature and the early attack on the young stems ("bines"). Under the influence of the disease the tips of normal, healthy-looking bines, when these are 5-7 feet high, are suddenly arrested and transformed into a tufted or "spike"-like growth. As many as seventy per cent. of the hop-plants ("hills") in a garden may show the disease, and in some cases all the stems ("bines") trained up may prove to be diseased. While in the case of the shorter basal "spikes" the mycelium appears to be continuous throughout their length, this is not necessarily the case with the longer diseased bines, where the mycelium may be absent from certain nodes, with the result that healthy lateral shoots may be produced. Within the stunted "spike" of the longer stems the mycelium is present close behind the growing point of the apical bud and extends along pith and cortex commonly for a foot or more. The extent of the mycelium within the pith is marked by a brown discoloration; in internodes where the pith is hollow the fungus has been found to accumulate hyphæ which form a lining for the hollow cylinder. These hyphæ give rise to oogonia and antheridia, and the pith eventually becomes lined with masses of oospores. These oospores, which hitherto have been reported as occurring only in the leaves, have been found in abundance within stems so early as mid-June, and in one case in May. The occurrence of oospores in "spikes" renders imperative the destruction of the latter, when they have been removed by the grower.

In several cases it has been found that the mycelium in the cortex penetrates the epidermis and produces masses of conidiophores on the outside of the stem, which is rougher and coloured light-brown in those areas.

On rare occasions a few conidiophores with conidia are found projecting into the pith cavity, in regions where formation of oospores is taking place.

E. S. SALMON.
W. M. WARE.

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Seed Dissemination of Nematoda.

RECENT American workers have directed attention to the fact that Nematoda attacking certain plants are regularly disseminated in the seeds of their host.

Whilst working on the relation of *Tylenchus dipsaci* Kühn to one of its common host plants, namely, the oat, the occurrence of various Nematoda between the pales was observed. Some correlation between such occurrence and a relatively poor development of the plant was also observed. Various genera were identified, notably Tylenchus and Diplogaster, but the forms most commonly present were small larvæ so immature that accurate identification was not possible.

Seeds known to be so infected and germinated under sterile conditions were, on later examination, found to harbour numbers of Nematoda of a species of the genus Cephalobus. It seems, therefore, that dissemination in seed must be accepted as one at least of the normal methods of spread of the species in question. Special interest attaches to this, for so long ago as 1906 Marcinowski showed that *Cephalobus elongatus* Sch. was capable of injury to cereals, while Steiner has recently shown that the species *C. subelongatus* Cobb. may cause damage to the foliage of Phlox plants.

W. E. H. HODSON.

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Newton Abbot, Devon.

Observed Stark Effect Patterns in Helium.

RECENTLY I have taken photographs of the Stark effect in helium which show quite clearly that the parhelium principal series line λ3965 has the pattern 1/1 (*i.e.* one component plane polarised parallel to the field, and one component circularly polarised perpendicular to the field) instead of the complex pattern 3/3 reported by T. Takamine and N. Kokubu (Mem. Coll. Sci., Kyoto, 3, 275, 1919). With improved experimental conditions, the new spectrograms prove that the simple displacements (1/1) reported by Stark and Nyquist for the members of the sharp and principal series are correct, and that the complex analyses claimed for some of these lines by Takamine and Kokubu were due to insufficient control over the Lo Surdo tube.

A further point of interest is the appearance of a new weak perpendicular component of the parhelium combination line λ4384. In a field of 40 kv./cm. this line has two components with wave numbers 22832·8 and 22839·0. This completes the pattern 2/2 for all members of the combination series $2P - mP$, $m = 4$ to 7 inclusive.

Two examples of the pattern 2/3 have been brought to light in this investigation. (1) The parhelium diffuse series line λ4922, in an electric field of 45 kv./cm., is found to have components with the following wave numbers:

par. 20293·9, 20295·8
perp. 20293·9, 20295·8, 20302·3, densities 4, 5 / 1, 2, 7

(2) The accompanying photograph (Fig. 1) shows two orthohelium lines in electric fields. As usual, a double image prism has been used to separate the parallel (upper) and perpendicular components. At the top of the photograph there appears to be but one line—the diffuse series doublet λ4472. Since this is not resolved, the analysis shown here is assumed to be that of the stronger component. In high fields, near the cathode, this line is deflected toward the left and split into two components. A very faint line in the normal undisplaced position is due to stray light not emitted by the main source. It is useful as a line of reference. Immediately at the right may be seen the combination line $2p_1 - 4b$ making its appearance in a very low field (Harry Nyquist, *Phys. Rev.*, 10, 226, 1917). This line has the pattern 2/3. Most of the components are over-exposed in order to show the new perpendicular component. The insert is a photograph of the perpendicular component of He λ3965 in fields up to about 50 kv./cm.

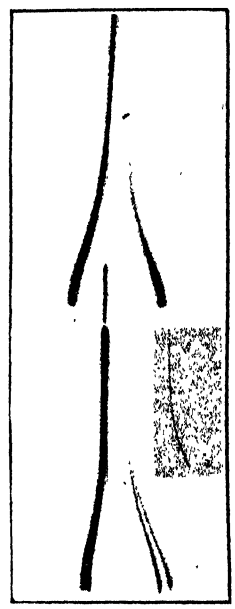

FIG. 1.—Orthohelium group λ4472 in electric field, and, on right, perpendicular component of He λ3965.

These patterns for helium series lines are identical with those claimed for the corresponding hydrogen fine structure components in the theory given by H. A. Kramers (*Zs. f. Phys.*, 3, 199, 1920).

J. STUART FOSTER.

McGill University, Montreal, Canada,
June 15.

The Word "Australopithecus" and Others.

WHEN Dr. Bather hints (NATURE, June 20, p. 947) that the word "Homosimiidæ" is not correctly compounded, he probably means that the compounding stem of *homo* is *homi-*, as in the Latin *homicida*. But "Australopithecus" is also incorrectly formed, for the compounding stem of *australis* is *australi-*.

Why will people venture to invent new names without consulting an etymologist? Neglecting this precaution, even a good classical scholar may flounder.

F. J. ALLEN.

8 Halifax Rd., Cambridge,
June 28.

Cancer Research.

REFERRING to the recent work on cancer by Dr. W. E. Gye, the statement in NATURE of July 18, p. 107, that Dr. Gye was "assisted by Mr. J. E. Barnard and Dr. J. A. Murray," which has also appeared elsewhere, attributing to me a direct participation in the work of Dr. Gye and Mr. Barnard, requires correction.

The very generous acknowledgment in Dr. Gye's paper in the *Lancet* sums up all my association with his researches. I should be lacking in candour if I permitted the suggestion of a closer collaboration to pass without a disclaimer.

J. A. MURRAY.

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The Natural Classification of Ferns as a Study in Evolutionary Methods.[1]

By Prof. F. O. BOWER, F.R.S.

IN the light of evolutionary theory the object of a natural classification of living things has ceased to be a mere catalogue, useful primarily for the recognition and accurate designation of genera and species. Such a classification is now understood to express, at least in some degree, the evolutionary relations of the organisms classified, though still it may be far from fulfilling its theoretical end. Kin will take place near to kin, and if the relationships be truly apprehended, the whole grouping of different forms will be such as to seriate them, so that those earlier in historical origin should precede those of later appearance. The series would lead from presumably primitive to presumably derivative types. But naturally a simple linear series, such as any catalogue must show, cannot adequately portray the highly complex relations of any well-represented group. Moreover, such relations are apt to be so obscured by the extinction of intermediate forms that, though this might at first sight appear to simplify the problem, it at the same time increases greatly the difficulty in recognising affinities, and often makes any definite opinion on relationship highly problematical.

In the face of such drawbacks many are disposed to regard the problem of natural classification as hopeless: and the results attained may appear to be mere expressions of personal bias. Moreover, the divergences of opinion expressed by different experts in the investigation of the same group are sometimes so great as to forfeit confidence in their methods. The critic may then conclude that the materials available for inductive argument are too disconnected, and positive data too deficient to lead to any satisfactory result. However true this may actually be, the demand may still be made that at least the classification adopted for any given group shall not violate, but rather accord with such settled conclusions of affinity as are founded upon an adequate field of observation comparatively treated. The wider the area of observation the more probable will it become that the grouping based upon it will be correct. This is indeed the theoretical basis of any classification that can be regarded as natural.

Many groups of plants, comprising at the present day numerous genera and species, appear so highly standardised as to give little scope for such treatment. The differences that they show are relatively minute, while in the absence of a consecutive geological record of their past history it may appear impossible to rank those differences in any probable phyletic sequence. This is the condition of the Angiosperms as a whole: consequently little headway has yet been made in their phyletic grouping: while opinions are by no means in full accord as to what characters are to be held for them as primitive, or as derivative. But it is otherwise with the Filicales. There are many thousand species of living ferns, distributed in more than a hundred well-marked genera. The range of variable characters which may serve for their comparison is wide: while the class is represented with a more or less consecutive history back to the Palæozoic age. These facts at once suggest that the class of ferns would provide material suitable for a searching experiment in the methods upon which a natural classification may be based.

We have seen that in order to obtain a stable result it is desirable to extend the comparison over a wide area of fact. The weakness of early groupings for the ferns has been that the area of comparison was too narrow. It involved chiefly the external form, and the sorus and sporangia, while anatomy and the characters of the gametophyte were scarcely used at all; nor was the palæontological evidence taken into account. Though naturally the features of the sporophyte, being more elaborate and also more varied, still take the prior place, all variable features should be used. In respect of each the limits of variability must be defined, and the question considered whether one extreme or the other should be regarded as primitive. Here a comparison with related fossils becomes important, and often indeed it is decisive, as in the conclusion that the Eusporangiate type is more primitive than the Leptosporangiate.

There are already twelve criteria of phyletic comparison in use in ferns, and others may probably emerge later. They are: (1) external form of the shoot; (2) architecture and venation of the leaf; (3) initial constitution as shown by apical segmentation; (4) the vascular system; (5) dermal appendages; (6) position and structure of the sorus; (7) indusial protections: (8) character of the sporangium; (9) spore-output; (10) morphology of the prothallus; (11) the position and structure of the sex-organs; (12) embryology. In respect of all of these, but naturally in varying degree, it is possible to distinguish a type that is held to be relatively primitive, from that which is derivative; moreover, so far as comparison with related fossils is possible, the palæontological sequence may be taken as a check upon conclusions, since its data are drawn from the most positive source that is available in comparative morphology. Further, it is found in the Filicales that the results of comparison, thus checked, run substantially parallel in respect of the several criteria upon which the comparisons are based. Exceptions do as a matter of fact occur; but the marked preponderance of parallel progression in respect of features so dissimilar as, for example, sporangia and antheridia, dermal appendages, conducting tissue, and spore-output, gives added confidence to the application of a comparative method so broadly based and so adequately checked.

From materials such as these it has been possible to draw up a verbal specification of a type which would embody all the relatively primitive features, and thus it might be visualised as a common archetype, which should represent something like that source from which we may presume that the class of ferns may ultimately have sprung. The specification would comprise an upright radial shoot, perhaps rootless, and forking equally if it branched at all; the distinction of axis and leaf ill-defined; the leaf, if recognisable as such, long

[1] Substance of three lectures delivered at the Royal Institution, May 21, 28, and June 4.

stalked, forking, with its segments narrow, and separate one from another; the general cellular construction robust, and without a single initial cell in the several parts; the conducting system consisting of simple tracts with solid xylem-core; the surface bare, or with simple hairs; the sporangia solitary, distal, and relatively large; the spores numerous in each sporangium, and all alike; and the opening mechanisms of the sporangia not highly organised. Naturally, since the prothalli are not as a rule preserved as fossils, little help is derived in checking the comparisons of the gametophyte; and it is omitted in the specification, which applies only to the sporophyte.

If the above specification be compared with the actual features displayed by the fossils of the Rhynie Chert, so beautifully revealed by Dr. Kidston and Prof. Lang, it will be seen that a substantial similarity exists. It is not suggested that any one of the Rhynie fossils itself represents an ancestor of the ferns. What does appear is that, among the vegetation of the earliest adequately known land flora, there existed plants which shared those leading features of the sporophyte which wide comparison of the ferns, living and fossil, has led us to regard as primitive for them.

Starting from such a source, which is not, as a matter of fact, far removed from what is actually seen in the extinct Botryopterideæ, a general advance may be traced through the ages, culminating in the modern Leptosporangiate ferns. The leading features of progression consist in departure from the upright habit, and equal dichotomous branching of axis and leaf; progressive webbing of the leaf-segments and adoption of netted venation; elaboration and progressive disintegration of the conducting tracts; substitution of flattened scales for simple hairs; transit of sori from distal or marginal to superficial positions; passage from the simple sorus with sumultaneous sporangia, to a gradate or a mixed succession of them; elaboration but often also a final abortion of indusial coverings; a progressive diminution of the individual sporangium, with corresponding increase of their numbers, and of the precision of their ejaculating mechanisms; finally, a diminution of the spore-output from each, from many thousands to definite numbers such as 64, 48, 32, 16, 8, or even in extreme cases to a single one. These progressions run substantially parallel, and accompany a progressive fining down of structure from the grosser Eusporangiate to the more delicate Leptosporangiate type.

Such evolutionary progression, traced by wide comparison in respect of many criteria, and checked by reference to the palæontological record, which in the ferns is both ample and consecutive, may be expected to yield material for argument as to the methods of evolution. In particular it makes possible views involving the essential factor of geological time, so often omitted or wholly forgotten in the evolutionary discussions of the moment. Between the Devonian Period and the present day there is spread out before us the whole drama of fern-evolution, including the changes profusely polyphyletic, embodied in the previous paragraph. We may fix our attention especially upon two marked features upon which the series throws light, namely, the slide of the sorus from the margin to the surface of the widening leaf, and the progressive elaboration of the vascular tissue with increasing size of the part it traverses. Evidence of progress in respect of both of these may be traced not only in the race, where the results are found to be hereditarily fixed, but also in some degree in the individual life, where they are seen to be still plastic.

The shifting of the sorus from the margin to the surface of the expanded leaf gives the biological advantage of protection from direct insolation during development. In some families, such as the Marattiaceæ, Gleicheniaceæ, and Cyatheaceæ, and in Todea, it happened early in geological history, and became hereditarily fixed with a high degree of uniformity. In others, as in the Schizæaceæ, Hymenophyllaceæ, and Dicksoniaceæ and in Osmunda, the primitive marginal position was retained. In some the transition from a marginal to a superficial position may be seen actually in progress, as in the Dennstædtiinæ and Pteridaceæ. The transition may be held as adaptive, and the steps of the adaptation may actually be followed in the individual development in such genera as Dennstædtia or in Pteridium. Such facts, the details of which will be found fully described elsewhere,[1] suggest that a widespread and polyphyletic phenomenon of adaptation is before us. It may be described as a slide of the sorus from the margin to the lower surface, which is clearly a biological adaptation. The genera quoted show that it is actually progressive in the individual development. The evidence suggests very strongly that there has been a widespread inheritance of a character primarily acquired by biological adaptation in the individual, and that it has become fixed as a heritable character not once only but repeatedly. The whole period of geological time from the Devonian onwards has been available for the process, which has happened in some phyla early, in others late, and is in some individual living ferns caught actually in the plastic or nascent state.

A similar argument may be advanced in relation to the progressive expansion and disintegration of the conducting tracts in ferns, which appears to be closely connected with the limiting factor of size, and the adjustment of the proportion of surface to bulk in an enlarging organism. The progressive expansion, elaboration, and even disintegration may be traced in perfection in the ontogeny of such ferns as *Gleichenia pectinata*, *Pteris podophylla*, or *Plagiogyria*. The elaborated result has become hereditarily fixed with characteristic differences in detail in many distinct races of ferns. The resulting structure provides features sufficiently stable to serve for far-reaching comparison.

Such arguments and such conclusions will of course be met by the objection that they traverse the doctrine of the non-inheritance of acquired characters. But it needs to be stated that the structural basis for this doctrine, however it may apply in animals, has no validity in the plant-body. In them there is no early segregation of somatic from propagative cells. These remain indistinguishable until a late state of individual development. In the absence of such structural segregation for plants, and in view of the positive evidence above advanced, we appear to be justified in concluding that in plants the distinction between fluctuating variations and mutations is not absolute.

[1] Bower, F. O., "The Ferns," vol. i., Cambridge University Press, 1923.

In other words, characters that are seen to be adaptive in the individual life are apt to become hereditarily fixed; and in the progress of geological time this has happened repeatedly.

The impressive address of Sir Francis Darwin as president of the British Association in 1908 in Dublin should be recalled. The observations and conclusions relating to ferns which have been acquired in recent years appear to be susceptible of interpretation only through some form of mnemic theory, such as he there disclosed. It is not only in the moral world, but perhaps also in the physical frame of living things that the methods of the importunate widow produce their result; and this will become the more plain where, as in the study of the ferns, the whole period of geological time from the Devonian Period onwards is available for the method to produce its structural effect. In recent discussions, too much stress has been laid upon the failure or success of laboratory experiments, which have extended at most over only a few years. Here in the ferns we see evidence derived from experiments carried on naturally and continuously since the Palæozoic age: and they indicate that adaptive characters are heritable. Preference should surely be given to those results which appear without any narrow time-limit. These show that, in the language of the mnemic theory, engrams are imprinted upon the propagative cells. The impress of an engram in ordinary life may be, and probably is, a relatively rare event. The difficulty in producing satisfactory evidence of the inheritance of acquired characters in brief laboratory experiments in itself indicates a high resistance of germ-cells to their reception. But prolonged comparative study of ferns, with their long geological history taken into account as a check upon its results, appears to justify the view that in them the difference between fluctuating variations and mutations is not absolute. It indicates rather that characters acquired by adaptation in the individual life may become hereditarily fixed if secular time be available.

The International Research Council.

THE International Research Council held its third meeting at Brussels in the Palais des Académies on July 7 and the two following days. The first meeting took place six years ago, in July 1919, when the statutes of the Council were adopted, and steps were taken to form the Unions of Astronomy, Geodesy and Geophysics, Chemistry, Mathematics, and Radiotelegraphy. The second meeting was held in July 1922, when some additional countries were invited to join the Council, and the formation of the Unions of Geography, Physics, and of the Biological Sciences was agreed to.

Since the second meeting nine countries have joined the Council, so that the number of adhering countries up to the present time is twenty-nine, to which Latvia and Tunis have now to be added, having been admitted at this meeting: thus the total membership is now thirty-one. Of this total membership, however, only seventeen were represented on this occasion at Brussels, namely: Belgium, Czechoslovakia, Denmark, Egypt, France, Great Britain, Holland, Italy, Japan, Morocco, Norway, Poland, the Union of South Africa, Spain, Sweden, Switzerland, and the United States. The votes assigned to each country depend on its population, and the total number of votes controlled by the delegates was 52.

It was reported to the Council that the former International Seismological Association had been dissolved, with the assent of all the countries who were members of the Association. It was proposed that the Council should accept responsibility for such of the property of the Association as had been taken over, and this was approved. The work which this Association formerly carried out is now undertaken by the Section of Seismology in the International Union of Geodesy and Geophysics.

The most important business that was before the Council related to certain modifications of the statutes which had been proposed by Australia, by Denmark and Holland, by Sweden and by Switzerland. All of these, though differing slightly in form, had for their object the removal of the restrictions which now limit the membership of the Council and the Unions related to it to those nations who joined in 1918, and others who have since been invited to join or have been elected under the existing statutes; these embrace only the Allies and neutrals of the War period, 1914–1918, the Central Powers being excluded. At the second meeting of the Council in 1922 a proposal was made to remove this restriction, but at that time it was not considered advisable to amend the statutes, and no action was then taken.

The procedure to be followed in modifying a statute lays down that "no change shall be made in the terms of the Convention except with the approval of two-thirds of the votes of the adhering countries." According to the president's calculation, the rule required 53 votes, so that even if a unanimous vote of all the delegates present had been obtained for any of the proposals, it would not have effected a valid change of statute. Thus although there was a majority of votes in favour of the changes proposed by Holland and Sweden, the statutes could not be altered. The situation, therefore, must remain as it was until the Council at another meeting comes to a different decision on this question, or agrees to modify the statute which requires a two-thirds majority of the votes, not merely of the countries present but of all the countries which belong to the Council. In the meantime the Executive Committee may by correspondence obtain a more representative opinion from all the adhering countries, for the statutes permit a country not represented by a delegate to vote by post.

The further proposal, submitted by France and Belgium, that membership of the League of Nations should qualify a country to be elected was not generally acceptable, and was therefore not adopted.

This result is in every way most unfortunate for international science: not only does it postpone the time when the Research Council will be truly international, but it also raises the question whether, as things stand, it will be possible to carry out the modification of any statute until the end of the present Convention in 1931. A full attendance of all the countries belonging to the Council at any meeting can scarcely be counted upon, though the votes of all of

them have to be taken into account in determining the two-thirds majority, so that a small group of dissentient votes may suffice to prevent a resolution being carried; or, as in the present case, a unanimous vote of those present may be insufficient to obtain the necessary majority. The serious inconvenience of this state of things was emphasised by several of the delegates at the present meeting, and the Executive Committee was requested to consider the situation, which must increase in difficulty as the membership of the Council is more widely spread over the world, with the view of suggesting a remedy.

The Council was not in favour of a proposal to rescind a resolution adopted at the meeting in 1922 requiring a country to join the Research Council before becoming a member of a Union.

A Committee which had been nominated provisionally by the Executive Committee in order to study the relations between solar and terrestrial phenomena was formally appointed by the Council for a period of three years, with power to add to its membership. The Committee will enter into communication with scientific men who are interested in the subjects to be studied by the Committee, especially those of countries which are not represented on the Committee. The constitution of the Committee is: Prof. S. Chapman (chairman), Prof. G. Abbetti, Dr. C. G. Abbot, Dr. C. Chree, M. H. Deslandres, General G. Ferrié, Dr. C. E. St. John, Dr. G. C. Simpson, and Prof. C. Störmer. The Committee held several meetings at Brussels on the present occasion. The Council had also before it a proposal from the International Mathematical Union advocating intimate co-operation between the Union and the Committee of Intellectual Co-operation of the League of Nations. As probably affecting other Unions also, the proposal was referred to the Executive Committee of the Council for consideration and report.

The period for which the president of the Council, M. E. Picard, had been elected having come to an end, his re-election was proposed by Prof. Lorentz and was unanimously agreed to. Dr. G. E. Hale and M. Lecointe being unable for reasons of health to serve on the Executive Committee, Dr. V. Kellogg and M. P. Pelseneer were elected to fill these vacancies.

The Union of Pure and Applied Physics, and that of the Biological Sciences, held meetings at Brussels during those of the Research Council. In the Union of Physics the desirability of full internationality being attained at the earliest possible date was urged, and a resolution to this effect was passed unanimously.

Industrial Chemistry at Wembley.

THE visitor to the British Empire Exhibition who takes it *au sérieux* will find a plethora of good things to stimulate his mind, and if his bent is towards science or its applications he will revel in the exhibits of the Government Pavilion and in many of the attractions of the Palace of Industry. In the latter the signs and portents of chemical enterprise should convince him that the days of "dogmatic slumber" are fast disappearing, and that although British chemical industry cannot compare in magnitude with such industries as engineering, mining, shipping, and textiles, they are nevertheless of equal fundamental importance. As in 1924, the chemical exhibits have been organised by the Association of British Chemical Manufacturers, and the same commanding position in the Palace of Industry has been utilised.

Comparing the chemical section with that of last year, the visitor will notice the same excellent lay-out, though he may regret the absence of exhibits from a number of well-known manufacturers. This absence does not, however, seriously impair interest, and in some ways is an advantage, because undue multiplication of similar exhibits is avoided, and there is more space available for effective display. On the other hand, the presence of rather an excessive number of vendors of "cures," perfumes, hair-washes, and other proprietary toilet articles is apt to confirm the man in the street in his prepossession that chemistry begins and ends with pharmacy. Another noticeable absence, both this year and last year, is that of chemical exhibits from the Dominions Overseas. Nowhere in the Exhibition do we find any tangible evidence that our sister nations are striving to realise their war-time aspirations of industrial independence and of security against physical aggression through the medium of a well-organised and effective chemical industry.

Although many of the exhibits are the same as those shown last year, there are a number of interesting novelties. The exhibit of Messrs. Burroughs Wellcome and Co. is a model of clear and attractive presentation, and its educational value is very high. Not only are medicinal and photographic chemicals displayed in artistic form and, where possible, in logical array, but concise information is also given concerning raw materials, methods of extraction, and preparation by synthetic methods; manufacturing operations are outlined, intermediate products are described, and miniature models of apparatus are exhibited. To attract the public there are crystals of various substances illuminated by coloured lights; and there is a very interesting display of historical relics—medicine-chests and first-aid outfits—carried by famous explorers, as well as dioramic views of the scenes of their activities.

Acids, alkalis, and other main products of the heavy chemical industry are so familiar that it must be difficult to devise new modes of display. Messrs. Brunner, Mond and Co., with their associated firms, have overcome this difficulty, partly by means of an attractive setting, and partly by exhibiting some up-to-date applications of well-known substances. Thus a number of new uses have been found for sodium silicate (of various composition), which has long been used in large quantities as a filling for soap (though it is said to have a slight detergent action). When mixed with powdered limestone it is now successfully used for hardening the concrete surfaces of roads, and the soft porous chalky limestone, which has hitherto been found useless for road-construction, has now found a valuable application. The mixture is sprinkled on to the prepared surface and then worked in with a soft broom. Three coats are applied, and the surface of calcium silicate so produced is more durable and more free from dust than surfaces made with the aid of coal-tar. Messrs. Brunner, Mond and Co. are also showing specimens of "grey pressed bricks," made of calcium silicate, which, though relatively heavy, are stronger and much less

pervious to water than common bricks, whilst their prepared surface renders unnecessary the use of plaster. Sodium silicate is coming into use as a means of preventing corrosion of water-pipes and cisterns, and of enabling aluminium utensils to withstand the action of hot solutions of soda. It is also used as an adhesive. Calcium chloride, a heavy chemical which for long awaited an adequate market, is used, *inter alia*, for spraying rubble tennis-courts to prevent the rising of dust.

The firm, Synthetic Ammonia and Nitrates, Ltd., shows a small case containing specimens of the products made in the nitrogen factory at Billingham-on-Tees. These consist of calcium nitrate, sodium nitrite, ammonium nitrate (not yet marketed), ammonium sulphate, and "agricultural chalk," which is calcium carbonate containing two per cent. of ammonium sulphate. In view of the enormous potential importance of this industry, the exhibit is disappointing. The mere display of products, most of them very familiar, gives the public no idea of the nature of the nitrogen problem and how chemists in all civilised countries are trying to solve it; and it should be possible to give the student and the technical man satisfying information without disclosing vital secrets of manufacture.

An interesting feature of the Brunner-Mond display is a continuous automatic-lantern exhibition depicting bird's-eye views of factories, the loading and unloading of goods, methods of transport, offices, etc., connected with this firm's world-wide activities. Messrs. Chance and Hunt, Ltd., are showing, in addition to their staple products, specimens of ferrous chloride, which is now used in making jointless magnesite flooring. The Castner-Kellner Alkali Co. has a small exhibit relating to the use of liquid chlorine and of chlorine derivatives of ethane and ethylene, bleaching agents, etc., whilst Electro-Bleach and By-products, Ltd., makes a special point of its sesquicarbonate of soda, which is a very concentrated form of soda for cleaning and other purposes.

Messrs. Albright and Wilson, Ltd., well known for their manufactures of phosphorus, show interesting exhibits relating to the fire-proofing of wood and the preservation of stone. By means of the "Oxylene" (secret) process, owned by the Timber Fire-proofing Co., Ltd., of Market Bosworth, wooden safes and their contents can now be protected from the effects of exposure to high temperatures. A deal fire-proof door is shown, one side of which became covered with adherent non-conducting charcoal on exposure to flames at a temperature above 900° C., whilst the other side barely became hot. The merits of Prof. A. P. Laurie's "silicon ester" as a means of preventing decay of building-stone are effectively indicated by specimens of treated and untreated materials. "Silicon ester" is made by the interaction of alcohol and silicon tetrachloride, and it acts by depositing silica in the pores of the stone, thereby strengthening it but not affecting its permeability. One of the chief attractions in the stand of the United Alkali Co. is an educational exhibit of "intermediates" derived from coal-tar, so executed as to bring out their genetic relationships. The Salt Union, Ltd., shows that it is moving with the times by displaying a table-salt which, as the name "Salodine" suggests, contains an iodine compound; and the British Cyanide Co., Ltd., exhibits a new colourless and odourless synthetic resin, made from thiourea, which is well adapted for making insulating materials and moulded articles like cups and saucers.

This year the dyestuff-makers have largely discarded strictly technical exhibits, and have co-operated in presenting artistic displays and colour schemes. Instead of being met with the usual array of bottled products, the eye is at once attracted by two large tents, with revolving tops, and a long corridor, all draped with coloured fabrics. Around are displayed articles, from carpets to candles, coloured with British dyes. Fine chemicals are well represented by Messrs. A. Boake Roberts and Co., the Graesser-Monsanto Chemical Works, Ltd., the Clayton Aniline Co., Ltd., Thomas Tyrer and Co., Ltd., B. Laporte, Ltd., and a number of others. In the exhibit of the first-named there is a good model of a three-column distilling plant by Messrs. Blair, Campbell and McLean.

Our two largest gas companies are, as usual, to the fore with luxurious displays, and there is an attractive co-operative exhibit by tar-makers of a rustic scene with an inn, garden, bridge, a tree with mechanical singing-birds, and a country road made up with "Tarmac." Unfortunately, the recent report of the Standing Committee on Rivers Pollution has severely condemned the use of tar on roads, because the washings are toxic to fish, particularly when the road surface is broken up, and it enjoins the use of bitumen instead. By way of counterblast there is shown in the scientific section a shallow tank containing live fish and plants supplied by water running over channels prepared with "specially refined" tar. Although the conditions in the tank are scarcely comparable with those in a stream, the exhibit is ingenious and attractive to the passer-by.

The scientific section is hidden away in the midst of the industrial chemistry exhibit. Its position may perhaps be justified as indicating that scientific research is the "heart" of chemical industry. The exhibit this year is devoted to educational exhibits relating to coal, salt, and food. The coal exhibit is the most comprehensive, containing excellent models of plant, but all are good. A small exhibit illustrating the properties, etc., of viscose and cellulose "silks," and that of some products obtained in the "Berginisation" of coal, increase the interest of this valuable section.

In the above account it has not been possible to mention more than a few of the exhibits, but there are many more of a high order. Those who are responsible for the success achieved during the two sessions will doubtless use the experience gained to do even better in the future. The tendency, already shown, to find substitutes for "bottled" products should be encouraged; there should be more models of plant and apparatus, and—what is entirely lacking in the present exhibition—economic information conveyed in the form of charts and diagrams. Those who stand for science in industry appreciate the fine efforts which so many chemical manufacturers have made in connexion with this exhibition; they would be even more appreciative if their thirst for knowledge could be assuaged by conversation with a few technical men who might be specially detailed to explain or demonstrate the processes and products displayed.

Recent Researches on the Causation of Tumours.

By Prof. WILLIAM BULLOCH, F.R.S.

A WEEK or two ago it was rumoured that remarkable additions had been made to our knowledge of tumours by Dr W. E. Gye, of the scientific staff of the Medical Research Council. Instantly, almost every newspaper took the report up, some of them announcing with sensational headlines that the problem of cancer was solved and that the disease was due to a small germ. Dr. Gye's collaborator, Mr. J. E. Barnard, F.R.S.—a well-known scientist—was said to have secured photographs of the virus, and it was alleged that it had actually been cultivated. What the real facts were, was only the property of a few, because the papers of Gye and Barnard were not published until some days later. In the absence of details, a short note appeared in NATURE of July 18—the day of publication of Gye's paper giving a general statement of the results said to be claimed, and so far as they were known. It is now possible to write more fully and with greater confidence as a result of the study of the papers just published (*Lancet*, July 18).

Unlike many fantastic hypotheses which have been proposed to explain the cause of tumours, the present one comes from a scientific worker who has the very highest credentials and is known not only in England but also all over the scientific medical world. Behind him is a wide experience, particularly of the kind of work on which he now reports, and he is known for his imaginative and critical powers, his sober judgment, and his high technical skill.

William Ewart Gye is a man about forty years of age who graduated M.D. Edinburgh in 1913 and came to London to be assistant in the laboratories of the Imperial Cancer Research Fund about a dozen years ago. His appearances in scientific gatherings stamped him at once as a quite unusual man, modest but efficient, full of scientific enthusiasm, but temperate and cautious in the estimate of his own work and that of others. During the War he carried out very important investigations which cleared up several of the mysteries in the pathology of gas gangrene and lockjaw and secured him a post on the staff of the Medical Research Council. When the Council inaugurated a scheme for the study of the unknown viruses of certain infective diseases, like distemper, Gye took his part, but early struck out on his own lines and, working by himself, has completed the research just published. This work is of the greatest interest and, if confirmed, will be found to open up entirely new fields not only in what has hitherto been a veritable slough of despond—cancer—but also in connexion with many other diseases, of unknown causation, affecting man and animals. Gye's paper in the *Lancet* is entitled "The Ætiology of Malignant New Growths" and is prefaced by a short paragraph quoted from a leader on the subject in the same issue. It is unusual and often unwise to attempt to forecast what the ultimate value of a scientific paper will be, but the *Lancet* is of opinion that the two papers of Gye and Barnard "mark an event in the history of medicine." This may or may not be so, and we may note that the leader writer, in the next sentence, is more moderate when he states that they may present a solution of the central problem of cancer.

The critical study of Gye's paper leads one to the conclusion that, if his results are confirmed by independent workers, he has made a discovery of the greatest interest and possibly of the highest importance to the well-being of man. Before dealing with his data as presented, and as the subject is one which will be followed by scientific as well as non-scientific readers, it would appear well to clear the ground and state what was commonly accepted on the subject of malignant disease before Gye's publication, and it may be affirmed at once that but little of this knowledge has been controverted by his work.

It is known that all races of man and animals are liable to the development of tumours or swellings—now called blastomata—which possess certain common and constant features. No tumour has yet been seen that was not composed of some tissue of the body of the individual in which it arose. For some unknown reason a tissue begins to grow in excess, and this growth, barring operation or accident, is unlimited in extent. There is an infinite variety in the structure of tumours arising from different or even from one and the same tissue, and quite early an important line of demarcation was drawn on practical grounds between tumours that were clinically or histologically benign and those which were malignant and destructive of life. The differentiation is, however, not always easy, or indeed always possible. From remote times, two special malignant tumours have attracted interest on account of their deadly character. These tumours—sarcoma and cancer—start in a particular tissue but early burst into other tissues. Invading blood-vessels and lymph vessels, and being swept away in the circulating blood, the cells are carried throughout the body, halting in numerous backwaters to produce secondary tumours or metastases. There is an irrefutable body of evidence, confirmed daily, that the secondary tumours are composed of cells which are the descendants of the cells of the primary tumour.

The central problem of tumour formation is to find out what has caused this aimless growth of cells previously—so far as one can judge—perfectly normal. It is this problem which Gye has attempted and is reputed to have solved. There have, naturally, been many hypotheses on the subject of the cause of tumours, but two have gradually been accepted as the most probable. In one, evidence has been sought experimentally and otherwise that the purposeless growth of the cells is due to some kind of chemical irritant acting on normal, or possibly abnormal, cells. The other view, early held and long studied, attributed the cause of tumours, particularly malignant growths, to the action of some extrinsic parasite which, entering the body, stimulated the cells to unwonted activities. Many parasites of microscopic size have been incriminated at various times during the last forty years, but none has fulfilled the test of tumour production experimentally, and however much the study of malignant disease suggests an infection, the vast majority of those with special knowledge were compelled to reject a parasitic hypothesis on various grounds. No parasite, not even that said to exist by

Gye, has by its inoculation caused by itself the development of a malignant or other blastomatous growth. Further, there is a marvellous specificity in all growths whereby they copy, in every degree of variation, the tissue from which they arose. Those facts forced investigators to the conclusion that, when one remembers the extraordinarily wide zoological range in which tumours occur, the cause is some deep-seated mystery connected with the processes of birth, growth, and decay of the cells of the body.

In 1902, C. O. Jensen, of Copenhagen, discovered by accident a malignant tumour in a mouse, and worked it out so carefully that his paper has become a classic in the literature. He failed to find any evidence of a parasite either in the original growth or in those transmitted by transplantation to other mice. He showed that no growths followed the inoculation of tumour cells that had been crushed. Since Jensen's time, many similar tumours have been studied and transmitted in an unbroken series of generations, and Jensen's statements have been confirmed over and over again. Even before Jensen, several workers, among whom we may specially mention Bellingham-Smith and Washbourn in England, had shown that certain tumour-like formations were transmissible from dog to dog, but the exact nature of the growths was the subject of mush dispute.

In 1910, a new, and, as it proves, highly important, work was published by Peyton Rous, of the Rockefeller Institute, N.Y. He found a tumour growing in the breast of a barred Plymouth Rock hen. The tumour proved to be transmissible to other hens of the same setting, and in structure was regarded as a genuine sarcoma. Transmission, at first, was not easy, but in the course of passage from one fowl to another the growth became more malignant in its effects and lethal within a few weeks. In 1911, Rous made the further, highly important, discovery that when portions of the sarcoma were ground up and passed through filter paper, or even through a Berkefeld Kieselguhr filter, the cell-free *filtrate* contained some "agent" which could communicate the sarcoma disease to normal fowls. No microbe could be seen in, or be grown from, the clear filtrate, and Rous left it an open question whether it was to be regarded as containing a living microbe. "It is conceivable," he said, "that a chemical stimulant elaborated by the neoplastic cells might cause the tumour in another host and bring about in consequence a further production of the same stimulant."

The fact that the cell-free filtrates were capable of producing tumours was something quite new, but was soon found not to be unique, for between 1911 and 1913 Rous, in conjunction with Murphy, Tytler, or Lange, found two other fowl tumours transmissible in this way. He also showed in the case of the first tumour ("Rous sarcoma I.") that ultra-violet light rapidly destroys the activity of the sarcoma cells without destroying the filterable agent associated with them. From irradiation experiments he made out that in the sarcomatous tissue there are apparently two elements capable of producing the growth. One will withstand drying, the other will not. The latter is the living transplantable cells, whereas the former is the tumour-producing agent.

Coming to Gye's work, full credit is given to Rous for his admirable researches on the Rous sarcoma I. It is with this tumour that Gye has mostly made his experiments. His main thesis is that the "agent" is really a living virus. This virus is incapable by itself of producing a tumour. For the latter, there has to be the co-operation of a second factor—the "specific factor"—also incapable by itself of inducing a sarcoma, but which enables the living virus to attack the cells of the inoculated animal and transform them into malignant cells. The impression gained from a careful perusal of Gye's paper is that he has more facts than he has yet divulged. The experiments he has given us are carefully thought out and precisely described. A medium—probably not the best one—is indicated in which he obtains "primary cultures"—"a term of convenience," he says, applied to the result of placing a fragment of tumour in the medium. He found that in a tube of "primary culture" the supernatant liquor becomes infective, depending on various factors of which anaerobiosis is said to be the most important. That the "primary culture" contains something living is suggested by the definite acid reaction which ensues when glucose, maltose, or lævulose are incorporated in the medium. No such reactions occur in the presence of mannitol, lactose, or sucrose. It is believed that the "agent" of the tumour diffuses out in the medium and that it disappears slowly (days).

Of fundamental importance for the support of Gye's views are his experiments on the action of chloroform on the tumour agent. It had been previously shown by Rous that carbolic acid, toluol or chloroform destroys the power of the "agent" to induce tumours. In a series of experiments, repeated, it is stated, with constant results, Gye shows that a "primary culture" incubated aerobically for three days at 37° C. produced no tumour when injected into fowls. The clear tumour filtrate thoroughly treated with chloroform was also incapable of inducing growth. But the two inert fractions mixed together were found to produce typical sarcomata. The interpretation given by Gye is that the chloroform-treated filtrate contains a labile chemical substance which in some way, unknown, renders the cells susceptible to the supposed virus, presumed to be present in the other fraction, which was incubated at 37° C. for three days. Gye's conception of a double factor was also supported by centrifugation experiments, for although it was not found possible to drive the virus to the bottom of the tubes spun at high rates, some concentration in special lined tubes did appear to occur. Of the two factors necessary for the production of a Rous sarcoma, Gye believes that one is particulate and is therefore "probably a virus," the other, uninfluenced by centrifugation, being a chemical substance. Since the supposed virus is incapable of producing a tumour, and since the tumours when they originate are specific, Gye admits that the "specific factor" must be the important thing when the action of the two is considered.

Attempts were made to demonstrate that the "virus" actually multiplies in cultures. In one experiment, a fifth subculture in direct line from a "primary culture" produced no tumour, nor did a chloroformed filtrate, but when the two were mixed,

tumours were produced and were lethal in twenty-three days. As each subculture represented a dilution of 1000 fold, the dilution of the matter in the "primary culture" would be 10^{15} if it had not increased.

These remarkable results with the Rous sarcoma I. were followed up on other tumours of known origin and history. They included a spindle cell sarcoma "37/S," the Jensen rat sarcoma, carcinoma of mouse "No. 63," and a rat sarcoma known as "No. 9." Directly or indirectly, experiments with these tumours confirmed the results with the Rous sarcoma I. In each case the "specific factor" was the important one, the virus being less so. Thus a chloroform extract from Rous sarcoma was found to be incapable of producing the disease. A "primary culture" from mouse cancer "63" was also inert when tested on fowls. The specific factor of the fowl plus the "culture" from the mouse produced sarcoma in the fowl. This astonishing result was also obtained in the case of an adeno-carcinoma of the human breast. Inert "specific factor" from fowl tumour, plus inert "primary culture" from human tumour, caused sarcoma in the fowl.

That briefly and perhaps imperfectly represents the main results of Gye's published work. Of the proof of the "virus" he speaks guardedly. It is said to be "almost certainly a virus." The idea of two factors in the production of a disease is not a new one. It has, indeed, long been a commonplace of medical writers that the development of most diseases requires the co-operation of two sets of factors. On one hand, the organism within which the morbid process is to unfold itself must conform to certain conditions of structure and function. This is the so-called "internal" cause. On the other hand, some agent, the "external" cause, actually or functionally outside the organism, must exert an effect peculiar to itself, and a property of its own structure, upon the organism which is in process of becoming the seat of the disease. The revolutions in medical knowledge which came from bacteriological discoveries showed that for most infective diseases the specific agent was the external one. Thus the tubercle bacillus is the specific element in tuberculosis. In the case of tumours—if Gye's work is confirmed—it would appear that the specificity is not resident in the virus but in the "internal" cause—a new conception in connexion with infective disease. Gye's work may be the central point round which the cancer problem revolves. It is certainly a long way from the complete solution of tumour formation, although one must be frank and congratulate Dr. Gye on opening up a new field pregnant with possibilities.

With reference to Mr. Barnard's paper, this deals largely with the question of the microscopic examination of "ultra visible" agents. The agent chiefly described is the microbe of bovine pleuro-pneumonia, in which various morphological types are reproduced. Very little is said of the "virus" of Rous sarcoma and other tumours except that the same morphological types can be seen as occur in bovine pleuro-pneumonia. Attention is directed to the care necessary in excluding various "bodies" which are seen in uninoculated tubes. Finally, there is a combined note by Gye and Barnard. Their exact words may be here reproduced. "Our belief that the small bodies seen and photographed are the actual virus depends partly upon the fact that control uninoculated tubes of medium have been invariably blank and partly upon the correspondence between the microscopical findings and the results of experiments on animals. This correspondence—allowing for the real difficulties in both parts of the common task—has been so close that although final proof has not been attained we are convinced that our conclusions are sound."

Current Topics and Events.

PRIOR to the War, there was in force an Order of the Board of Agriculture compelling the slaughter of cattle discovered to be suffering from tuberculosis of the udder and giving partial compensation to their owners for this compulsory action. This Order is about to be renewed for all cattle suffering from tuberculosis of the udder or from tuberculous emaciation, one-fourth of the market value if the disease is advanced, or otherwise three-fourths, being given to the owner. In these circumstances it will be interesting to ascertain how many are certified as suffering from advanced disease. From the same date the use of any cow for producing milk which gives tuberculous milk will be prohibited, and owners and veterinary practitioners are required to notify tuberculosis in cattle so soon as recognised by them. The last paragraph of the circular letter announcing the matter briefly summarised above adds somewhat deprecatingly: "The new Order represents the most that is practicable at the present time in the direction of securing the eradication of bovine tuberculosis, and in contributing to the production at the source of a milk supply free from bovine tubercle bacilli."

THIS statement on the official attitude in Great Britain towards bovine tuberculosis is commendably frank, and adequately reveals the weakness of the situation and the action—or is it merely "gesture"?—directed towards remedy. Disease is allowed to continue to become obvious to the farmer, and so obvious that he can no longer conceal it, or until a veterinarian is called upon the scene, and then the local authority—hereafter three-fourths of the money probably will be paid out of Exchequer funds—will pay three-fourths or one-fourth of the value of the condemned beast. There are some hundreds of herds of cattle in Great Britain from which tuberculosis has been eliminated by well-known and practicable scientific methods. Is it not likely that the resumption of compensation to the owners of beasts with advanced tuberculosis will delay the multiplication of tuberculosis-free herds? Moreover, is it not arguable that, in the interest of the many thousands of young children in Great Britain who annually are made victims of tuberculosis from drinking infected milk, it might be better to save the millions sterling which will be paid in compensation for disease which

so extensive as the Union of the Socialist Soviet Republics. The scientific work of the Congress was discussed by the following five sections: (1) meteorology, aerology, and general topics; (2) actinometry, electro-meteorology, atmospheric optics, and acoustics; (3) climatology; (4) dynamic and synoptic meteorology; (5) terrestrial magnetism, seismology, and graviometry. Beside these five sections a special commission for the study of drought and its peculiarities was organised. 335 reports were presented for the consideration of the assembly, 75 relating to questions of organisation and 260 scientific reports. There were no less than 511 delegates at the Congress.

THE third International Congress of Entomology opened its meetings at Zurich on Monday, July 20, after a reception of the delegates on the evening of Sunday, July 19. The first of these Congresses was held at Brussels, and the second at Oxford. In August 1914 the third was to have met at Vienna, but circumstances made this impossible. Science, however, is international, and "Time the Healer" suggested the resumption of these meetings, and Zurich was chosen as neutral ground. About 200 members are in attendance, 60 of them from Britain. Nearly all the European countries are represented—though there are significant exceptions—as also India, Canada, South Africa, and the West Indies. The United States is represented by Dr. L. O. Howard and others, while there are representatives from Egypt and Mexico. Switzerland is naturally well represented, and the president is Dr. A. von Schulthess. A very full programme has been arranged under the sections morphology, systematic entomology, biology and development, bionomics, and nomenclature. The social side has not been forgotten. In addition to evening meetings for social intercourse, an excursion has been arranged to the Uetliberg, one of the highest points in the neighbourhood of Zurich, from which good views of surrounding peaks may be had; and a sail round Lake Zurich. A banquet is being held on the night of July 24. On July 25, after some sectional meetings in the forenoon a general business meeting is being held, at which the time and place of meeting for the next Congress will be arranged.

THE Trustees of the late Sir William Dunn have made a donation to the Medical Research Council of 2000*l.* per annum for a period of five years to be used for the promotion of research work in medicine at the discretion of the Council. The Medical Research Council, in accepting this generous benefaction, has intimated that for the present this special Dunn Fund will be applied mainly to the furtherance of the organised studies of filterable viruses which it is supporting, and in particular to the recent developments of this work in relation to cancer by Mr. J. E. Barnard, Dr. W. E. Gye, and their colleagues. It will be recalled that the Dunn Trustees have already made many important benefactions for the advancement of medicine. They have endowed a chair of pathology at Guy's Hospital, London, and erected a School of Biochemistry and endowed a chair in biochemistry, now held by Sir Frederick Hopkins, at Cambridge; they have given a new building for the School of Pathology at Oxford, now being erected, and have provided equipment for the School of Pharmacology there. They have also built and equipped laboratories for the University Medical Clinics at St. Bartholomew's Hospital, St. Thomas's Hospital, and the London Hospital.

AT the annual general meeting of the Faraday Society, held on July 6, the following officers were elected: *President*, Prof. F. G. Donnan; *Past-Presidents*, Sir Robert Hadfield, Prof. Alfred W. Porter, Sir Robert Robertson; *Vice-Presidents*, W. R. Bousfield, Prof. C. H. Desch, Dr. W. H. Hatfield, Prof. W. C. Lewis, Mr. C. C. Paterson, Prof. A. O. Rankine, Dr. E. K. Rideal; *Treasurer*, Mr. R. L. Mond. During the past year general discussions on the following subjects were held: (1) "Fluxes and Slags in Metal Melting and Working," (2) "Physical and Physico-Chemical Problems relating to Textile Fibres," (3) "The Physical Chemistry of Igneous Rock Formation," (4) "Base Exchange in Soils." It is the policy of the Society to co-operate wherever possible with other scientific societies, and three of these discussions were held jointly. The policy of co-operation is also extended to the American Electrochemical Society, in that by a mutual arrangement the Transactions of each society are supplied to the members of the other society at a special rate. In addition to the general discussions, four ordinary meetings were held. One section of the Report refers to the convention that should be adopted as regards the sign of the potential on an electrode. The Council is not prepared to make an official pronouncement on the subject, and the opinion is expressed that such matters should be settled by international agreement. During the year thirty-three new members were admitted to the Society. There was an adverse balance of 293*l.* on the year's work, due to the great amount of material published. While loth to diminish the Society's activities, it has been decided to limit the general discussions for the time being to two a year, and it is expected as a result to balance income and expenditure during the present year.

ACCORDING to the annual report of the Trustees of the Beit Memorial Fellowships for Medical Research, there were last year 93 fellows on the Fellowship register and 23 Fellowships were occupied. Further elections have taken place as follows: Senior Fellowship (600*l.* per annum for 3 years), Mr. H. D. Kay; 4th Year Fellowships (100*l.*), Mr. E. B. Verney and Mr. J. L. Rosedale. Seven Junior Fellowships (350*l.* per annum for 3 years) were also awarded, and the nature of the proposed research and place where the fellowship is tenable appears after the name of the new fellow: Dr. G. H. Eagles, to study the specific agglutinogenic properties of streptococcus scarlatinæ and the possible further specific grouping of hæmolytic streptococci occurring in other pathological processes (The Lister Institute of Preventive Medicine, London). Miss D. M. Needham, (1) a study of the oxidation-reduction potential of various organisms and tissues; (2) a continuation of the study of the pancreatic factor inhibitory to lactic acid formation

in muscle (Bio-chemical Laboratory, Cambridge). Dr. E. N. Chamberlain, effects of the anterior lobe of the pituitary gland on the liver and other organs of the body; investigation of the relation of pituitary and other ductless glands to cholesterol metabolism and their inter-relationships (Johnston Laboratory of Bio-Chemistry, University of Liverpool). Mr. E. N. Allott, the growth of bacteria on artificial media: to attempt to grow bacteria on purely artificial media, consisting of simple compounds, such as simple sugars, amino acids, and salts (Bio-Chemical Laboratory, Cambridge). Mr. F. C. Kelly, to continue research on iodine metabolism, especially the iodine requirements of animals and the influence on nutrition of diets deficient in iodine (Bio-chemical Laboratory, Cambridge). Mr. D. E. Denny-Brown, to investigate spastic paralyses, decerebrate rigidity, and allied conditions, more particularly with regard to the influence of the sympathetic nervous system upon them (Physiological Laboratory, Oxford). Mr. B. S. Platt, the relationship existing between the formation of peroxides by bacteria and certain of the phenomena of immunity (Bacteriological Laboratory of the Department of Pathology, The School of Medicine, Leeds). Thus three of the new fellows of the seven will be at the Biochemical Laboratory, Cambridge.

WE regret to announce the death, on July 14, at the age of sixty-seven years, of Dr. F. E. Beddard, F.R.S., formerly prosector of the Zoological Society, London, and naturalist to the *Challenger* expedition, who was distinguished for his work on the Oligochæta and on the structure and classification of birds.

THE Civil Service Commissioners have appointed Mr. A. C. Stephen, at present a junior naturalist on the scientific staff of the Fishery Board of Scotland, to be assistant in the Natural History Department of the Royal Scottish Museum, Edinburgh, in succession to Dr. E. L. Gill, recently appointed Director of the South African Museum, Cape Town.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: A lecturer in chemistry and physics at the Exeter Diocesan Training College for Schoolmasters.—The Principal, St. Luke's College, Exeter (July 31). A botanist (temporary post) at the Royal Botanic Gardens, Kew.—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (August 5). A resident tutor for mathematics and physics at the Borough Road Training College.—The Secretary, British and Foreign School Society, 114 Temple Chambers, Temple Avenue, E.C.4 (August 8). Two junior engineers at the Forest Products Research Laboratories of the Department of Scientific and Industrial Research, South Farnborough.—The Secretary, The Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (August 8). An evening lecturer in bacteriology at the Battersea Polytechnic.—The Principal. A full-time lecturer for day and evening classes in engineering at the Erith Technical Institute.—The Principal. A graduate master for physics and chemistry at the Andover Grammar School.—The Director of Education, The Castle, Winchester. A lecturer in science, including biology, nature study or gardening at the Diocesan Training College, Ditchling Road, Brighton.—The Principal.

Our Astronomical Column.

RETURN OF WOLF'S PERIODIC COMET.—The opening, on July 13, of the meeting at Cambridge of the International Astronomical Union was marked by the detection, by Dr. Stobbe at Bergedorf Observatory, of this interesting periodic comet, which has been observed at nearly every return since its discovery in 1884. Prof. Kamiensky, Director of the Warsaw Observatory, was present at Cambridge and received many congratulations on the brilliant success of his prediction; the error of his predicted place was only 4′, although the perturbations by Jupiter at the last return were so enormous, that the perihelion distance has been increased by an entire astronomical unit, the orbit having, in fact, reverted to its form of fifty years ago when Jupiter acted to reduce the perihelion distance. The perturbations during the whole fifty years have been investigated by Prof. Kamiensky, and the successful prediction gives evidence of his skilful and accurate work.

The comet was of magnitude 15 at rediscovery on July 13, and will remain too faint for ordinary telescopes throughout the apparition. It will, however, be brighter by a magnitude or two when it reaches perihelion on November 8.

Brooks' Comet, the perturbations of which have been investigated by Prof. Dubiago, also suffered large disturbances by Jupiter at aphelion, and is also due at perihelion on November 8. Search for it and for Faye's Comet (due at perihelion about August 6) is now being made. Borrelly's and Kopff's Comets are also due in a few months, so that comet searchers are being kept busy. Tempel's Second Comet has brightened considerably, and is now an easy telescopic object. It has a short tail.

NOVA PICTORIS.—*Astr. Nach.* 5379 contains an interesting note on this Nova by J. Hartmann, of the La Plata Observatory. The Nova had been under observation there from May 27 to June 5, during which time its brightness increased slowly, as the following table shows:

	Mag.		Mag.		Mag.		Mag.
May 27.	2·8	May 29.	2·5	June 1.	2·1	June 4.	1·9
,, 28.	2·6	,, 30.	2·4	,, 2.	2·1	,, 5.	1·8

(Dr. Spencer Jones states that it afterwards attained the first magnitude.)

The increase of light has been more gradual and has lasted longer than in most Novæ; and the changes in the spectrum were also more gradual.

Hartmann obtained photographs with a small single prism spectrograph. These showed a continuous spectrum of the first type, with numerous strong absorption lines, of which the *H*, *K* calcium lines were the strongest, followed by those of hydrogen, helium, magnesium, etc. The hydrogen lines H_β, H_γ, and several other lines, showed a faint emission line on the less refrangible side of the absorption one. He, like Dr. Spencer Jones, holds out hopes that the somewhat unusual behaviour of this star may add materially to our knowledge of the nature of the processes that give rise to these outbursts.

It is interesting to note that Mr. Watson, who discovered this Nova, appears to have been the first to detect the outburst of Nova Aquilæ in 1918, so that he, like Mr. Anderson, has the record of two brilliant Novæ. It is fortunate that this Nova is circumpolar at the southern observatories, so that it will be possible to follow its decline without any break through the time of its conjunction with the sun.

Research Items.

CU-CHULAINN AND TOTEMISM.—In *Man* for June, Dr. Géza Roheim, whose ingenious and suggestive psychoanalytic study of totemism in Australia has just been published in Great Britain, applies the same analytical method to the Cu-chulainn cycle of Irish legend with reference to its bearing upon the problem of totemic origins. Not only is the dog taboo of Cu-chulainn probably totemic, but also he becomes a dog by killing a dog. In other words, the legend contains more or less veiled references to the father-and-son conflict for the women of the Cyclopean family, from which, Freud holds, totemism and exogamy arose; of the animal symbol arising out of a feeling of guilt for the act of parricide; and of incest committed by the hero. Cu-chulainn slays the dog of Cu-lain the smith, and serves in its stead, as other Aryan heroes served a term of apprenticeship with a smith, from whom they usually obtained their terrific weapon. But the smith and his dog are to be regarded as identical and the former represents the father. The slaying is therefore parricide. Cu-chulainn fights with and kills his own son; but Lugaid, who deals him his death-blow, is probably also his own son by an incestuous union, although ostensibly the son of Curoi. Curoi, the archaic form of the Oak King, is also to be regarded as the father of Cu-chulainn by whom he is killed. If then the smith is equated with his hound, the combat is between two heroes of the dog clan, and when Cu-chulainn breaks the taboo he is slain by his son Lugaid, a parallel being the case of the Baja King, who eats his totem animal when death at the hand of his son and heir draws near.

MORPHOLOGICAL DIFFERENTIATION OF BACILLUS TYPHOSUS.—L. Nicholls and E. Burgess direct attention in the *Ceylon Journ. of Science*, Sect. D (Medical Sc.), vol. i. pt. 2, 1925, p. 47, to the discrepancies which occur in text-books between the sizes given in the text and the magnifications stated under the illustrations respecting certain micro-organisms. They believe that were more attention given to the accurate comparison of the size and morphology of different organisms, much help would be derived for purposes of differentiation and identification. As an example, they have compared the morphology of *B. typhosus* with that of 40 other bacilli isolated from water. The organisms were grown on three standard media. (1) ordinary nutrient agar, (2) salt (3 per cent.) nutrient agar, and (3) salt-free peptone agar. Stained preparations were made and photographed under similar conditions. It was found that the *B. typhosus* could be distinguished almost at a glance from any one of these 40 water organisms by its characters when grown on these media. As regards the 40 water organisms, these corresponded morphologically to about 30 species, which agreed well with the results obtained by an extended series of culture and fermentation tests.

THE BRITISH FRESHWATER PEARL MUSSEL.—Considering that it is still an article of economic value, although less so than formerly, it is remarkable how imperfect is our knowledge of the life-history of the British freshwater pearl mussel. What is known has been admirably summarised by Mr. J. Wilfrid Jackson, of the Manchester Museum, in the introduction to his address to the Conchological Society on "The distribution of *Margaritana margaritifera* in the British Isles" (*Journ. of Conch.*, 17, No. 7), a paper all the more valuable on account of the numerous references to original sources of information. The mollusc has a remarkably wide circumpolar distribution, and exhibits persistent specific characters. Nevertheless, although the glochidial stage is known, the transitional stages between that and the adult are unknown and unrepresented in collections save for four young shells, in Mr. Jackson's own possession, coming from the River Conway. What the habitat of the young shells may be is at present a mystery (cf. Prof. A. E. Boycott in NATURE, August 23, 1924, p. 276). One would infer that they resort to deep water, since in shallow they would have been found long ere this. At the same time it should be observed, although not emphasised by Mr. Jackson, that these young shells might easily be mistaken for the juveniles of a species of Unio, because they are not black like the adult, nor do they exhibit the characteristic concavity of the ventral margin, whilst they are furnished with a complete set of hinge teeth similar to those of Unio. The assertion has been made by Dr. Haas that Margaritana (or, as it should be called, Margaritifera) is intolerant of hard water, and certainly it obviously shows a preference for soft waters, which makes it difficult to explain the markedly thick shells of the species. Prof. Boycott's appendix to Mr. Jackson's address, however, shows that this question evidently requires further investigation. A very full account of the distribution of the single British species, accompanied by a most instructive map, forms the conclusion rather than the bulk of the author's very valuable paper, to which we are glad to note there is to be a second part dealing with the past history of the mollusc.

RED CLOVER.—Critical studies on the pollination, fertilisation, and breeding of red clover have led to conclusions of practical importance to agriculturists (R. D. Williams, Welsh Plant Breeding Station Publications, Series H, No. 4). Under ordinary conditions red clover is not self-fertilised, but a small number of plants are self-fertile if artificially self-pollinated, individual plants varying in the degree to which they are capable of this. The property of self-fertility is probably inheritable, and is greatly increased if pollination is effected before the flowers open, but so little seed is produced that it is doubtful if self-pollination can be of much practical use in the breeding of red clover. Humble bees are the chief agents in effecting cross-pollination at Aberystwyth and in Montgomeryshire, honey bees playing but a very small part. Six species of humble bees were observed on red clover, *B. agrorum* and *B. hortorum* being by far the most numerous and important, probably being responsible for 70 to 80 per cent. of the total yield of clover seed in these districts. The seed yields are to some extent reduced by robber bees, *B. terrestris* and *B. lucorum*, and it is suggested that their depredations might be reduced by growing small areas of *Vicia villosa* near the clover, as this is a most attractive bait for these insects. As the bees are most abundant in early August, the yield of seed is much increased if the flowering of the clover is postponed until that time by means of judicious cutting of early strains or by growing late flowering strains. Larger yields might be obtained if more bees were available, and investigations are in hand with the view of increasing their numbers by judicious encouragement. Various methods of artificially breeding red clover have been tried, hand cross-pollination and controlled cross-pollination by humble bees being the two most promising methods of attack. Hand pollination is useless when many seeds are required or several plants are being intercrossed, but humble bees confined in various types of cages prove to be

very efficient agents, especially *B. agrorum*, *B. hortorum*, and *B. helferanus*.

PRODUCTION OF ALCOHOL FOR MOTOR FUEL IN THE TROPICS.—The question of making an efficient motor fuel in the tropics, where imported spirit is expensive, is at present attracting considerable attention. Various materials have been suggested, and in some cases tried, as a source of power alcohol, such as starch-containing roots, and cellulosic residues from the sugar and other industries, but one of the most valuable appears to be the sap which may be collected from the flowering shoots of the Nipa palm of the Far East. Considerable work has been done in the Philippine Islands in ascertaining the suitability of this palm for the production of alcohol, and quite recently an experimental plant has been erected in the State of North Borneo. The plant is being run under the direction of the local Department of Agriculture, and an account of the results of the first year's working, based on a memorandum supplied by the British North Borneo Company, is given in the current issue of the *Bulletin of the Imperial Institute*, published by Mr. John Murray. There are about 300,000 acres of Nipa palm in North Borneo, occurring in nearly solid stands of 5000 acres or more. The sap flows for only six months in the year, but it is estimated that during this period 900,000,000 gallons of sap capable of producing nearly 60,000,000 gallons of alcohol could be obtained. The results of the first year's working of the experimental plant came up to expectations in every way. The still was only capable of producing 100 gallons of alcohol per working day of 12 hours, and the costs of running such a small plant were naturally somewhat high, but it is shown that a permanent plant producing not less than 1000 gallons per day should prove a commercial success.

FORMATION OF MALACHITE.—The May issue of the Journal of the Chemical Society contains a paper on the mechanism of the formation of malachite ($2CuO, CO_2$) from basic copper carbonate, by J. R. I. Hepburn. At ordinary temperatures the transformation appears to be caused through the intermediate agency of an aqueous solution of carbon dioxide or sodium hydrogen carbonate. In the former case normal malachite crystals are formed; in the latter, sphærocrystals are produced, probably through crystal growth in a colloid medium (unchanged basic copper carbonate). Gelatin retards the change. The formation of malachite at 100° (by thermal decomposition of the blue solutions prepared by dissolving the basic carbonate in saturated sodium hydrogen carbonate) occurs as a surface film of interpenetrating spharocrystals, which is disrupted into individual crystals on further boiling. The direct cause of the change is attributed to loss of carbon dioxide from the sodium hydrogen carbonate at 100° with formation of the stable double salt Na_2CO_3, $NaHCo_3$, $2H_2O$ and malachite. Gelatin likewise retards this change.

THE SODIUM SPECTRUM.—The July issue of the *Philosophical Magazine* contains a short communication from Prof. F. H. Newman, describing a successful attempt to obtain the spectral lines of sodium vapour due to changes of orbit involving less energy than that necessary for ionisation. The sodium vapour was contained in a triode tube of quartz maintained at 350° C. in an electric furnace. The electrons were supplied by a dull tungsten filament, and between the filament and the grid an increasing electromotive force was applied, the spectrum produced being photographed by means of a quartz spectrograph. After applying a correction of 0·4 volt to the observed potential to get the potential corresponding to the energy with which the electrons pass through the grid, the author found that, in accordance with theory, at 2·2 volts the doublet 5896-90 only appeared, at 4·0 volts the doublet 3303-2, at 4·4 volts the doublet 6161-54, and at 4·6 volts the doublet 5688·3 appeared in addition.

MASS OF COMPOUNDS OF SILVER WHEN STRONGLY ILLUMINATED.—Messrs. P. P. Koch and B. Kreis describe, in the *Zeitschrift für Physik* of May 16, measurements made on particles of silver bromide and silver chloride, the mass of which was about 10^{-11} gr. The particles were made to float in air in the electrostatic field of a condenser, in which they were observed by means of a microscope. The particles were strongly illuminated by means of an arc lamp and a powerful condenser; the mass being determined before and after illumination by means of measurements of the condenser voltage and of the charge of the suspended particle. The intensity of illumination employed was so high as 67×10^6 metre candles; and it was found that in a short time the loss of mass was so great as 25 per cent. This loss appears to be due to separation of the halogens. Silver iodide under the same conditions showed only very small alterations in mass. The apparatus may be regarded as a very sensitive microbalance, in which particles of the same order of size as those in a photographic plate can be weighed, and the theory of photographic action can be directly tested.

LOUD-SPEAKERS.—The Marconiphone Co., Ltd., of Marconi House, Strand, now manufacture a loud-speaker which enables anyone to address an audience of many thousands and at the same time to be heard by equally large gatherings up to a distance of about 150 miles with the help of the Post Office land wires. The total equipment can be purchased outright or can be hired for 5*l*. per week. A powerful voice is no longer a necessity for a public speaker, and this ought to improve the quality of "orations" as the number of possible orators is largely increased. The distinguishing feature of the Marconi instrument is that it responds with equal sensitivity to all notes in the musical scale whether the sound originates 100 feet or 10 inches from its position. Recently a nightingale's song was broadcasted from the London broadcasting station, 2LO, by this device. The bird was singing about 100 feet away from the instrument, yet the song could be heard almost perfectly by broadcasting listeners. The apparatus has many points of difference from domestic loud-speakers. The construction is on the moving coil principle, and the diaphragm is of rubber and not of metal. As it has no natural or resonant frequency of its own, it is practically free from nasal defects, and there is no metallic timbre. The normal working range of one of these loud-speakers under reasonably silent conditions is approximately three-quarters of a mile.

SORPTION OF GASES BY GRAPHITE.—The sorption of oxygen by "activated" graphite forms the subject of a paper by D. H. Bangham and J. Stafford in the Journal of the Chemical Society for May. If s is the quantity of oxygen sorbed at time t after its introduction to the graphite, then the relation $s = kt^b$ holds, k and b being constants, both for ordinary graphite and for graphite containing hydrogen sorbed in a discharge tube. The results seem to indicate that the sorption of oxygen by ordinary graphite is due more or less directly to the hydrogen which it contained on manufacture. No water seems to be produced by the sorption of oxygen by graphite containing hydrogen; the sorbed gases may be pumped off as such.

The Nature of the Cell Membrane.

IS there a semi-permeable membrane to the cell? This question is examined by Prof. L. Lapicque in a review of very general interest which accompanies seven more technical contributions in animal, vegetable, or general physiology, in the first number of a new French journal, *Annales de Physiologie et de Physicochimie biologique* (Paris: Gaston Doin; annual subscription 45 francs outside France). The following, save for reference to some recent cognate American work, is based entirely upon Prof. Lapicque's stimulating and timely article.

Lapicque admits at the outset that he finds the conception of a semi-permeable membrane around the cell a hindrance rather than a help in the interpretation of the behaviour of the cell; he therefore critically examines the case for such a membrane as presented by Bayliss in his great text book. The idea of a membrane arises naturally when it is realised that protoplasm, though behaving in many ways as a protein sol, can frequently exist in contact with water without dispersing in colloidal solution throughout the aqueous medium. Clearly there is then a protoplasm water interface, and probably every one would agree that protoplasm at this interface has different properties from those characteristic of the main mass of protoplasm. Do these properties, however, necessarily include a different penetrability to solutes which justifies its distinction as a semi-permeable membrane enveloping a mass of readily permeable plasm? Even the advocates of the membrane will probably agree it is a phenomenon of the surface and that particles of protoplasm may lose and regain these surface characteristics as they leave or enter the surface layer. Certainly the ease with which the protoplasmic surface changes in amœboid movement, leaving no collapsed membrane as the surface retracts, suggests that any change undergone as protoplasm enters the surface layer is reversible in nature. Whenever a permanent structural membrane can be identified at the surface of the cell, it is something distinct from the surface of the protoplasm, as is the cellulose wall of the plant, and is not the seat of any semi-permeable properties shown by the protoplast, so that in plasmolysis the plant protoplast withdraws itself inward from the permeable cellulose wall around it. The semi-permeable properties of the hypothetical membrane are usually interpreted as due to a sieve-like action. From this view-point no non-living semi-permeable membrane has been shown experimentally to be impermeable to molecules of less than about twenty atoms. The living membrane, however, is assumed to control the passage of inorganic ions. One may invoke the view that such ions move accompanied by a cluster of water molecules, but the fact remains that the non-living membranes fail to arrest their passage.

The distribution of ions upon either side of a semi-permeable membrane is now frequently attributed to the Donnan equilibrium, when a non-diffusible colloid on one side of the membrane forms ionisable salts with electrolytes. Consideration of the case of gelatin, however, shows that so long as the colloid is non-diffusible, no special membrane is required for the existence of a Donnan equilibrium.

Thus whilst for mathematical and physico-chemical argument the ideal semi-permeable membrane is a necessary concept, in experimental fact it has never been demonstrated, and there are considerable difficulties in assuming its existence. For example, botanists realise that inorganic salts must diffuse freely into the plant, and they interpret experimental observations of recovery from plasmolysis induced by external concentrations of inorganic salts as evidence that such diffusion is occurring. On the other hand, present data as to the entry of salts, as summarised recently by Stiles in his monograph upon permeability, do not support the assumption that salts will diffuse through the plant protoplast until the ratio of salt concentrations in external solution and in the vacuole will be unity.

Bayliss argued that the resistance of the cell to the electric current, in view of its content in free electrolytes, could only be explained on the assumption of semi-permeability. Lapicque points out that if this was the true explanation, the cell would behave as a condenser in an electric field, and that once the cell was fully polarised no more current would pass. Actually the high resistance may be explained equally well if protoplasm is regarded as a permeable but highly viscous medium.

Bayliss also stipulated the existence of a membrane on the following grounds: (1) In the presence of various electrolytes in solution the cell undergoes a permanent change in volume; (2) the electrolytes within and without the cell differ in kind and in concentration. Lapicque deals with these arguments at some length. The change of volume of the vacuolated cell is admitted, but so also is the fact of recovery from plasmolysis, which shows that we are dealing with slow penetration of salts, not semi-permeability.

In any case this phenomenon is exhibited by the whole thickness of the cytoplasm, there is no evidence of the special rôle of a surface membrane. In the normal non-vacuolated animal cell, contraction of volume also takes place in the presence of salt solution, but this phenomenon cannot be attributed to the osmotic withdrawal of water from a non-existent vacuole, and is paralleled by the behaviour of gelatin and many other colloids, without superficial semi-permeable membranes, when placed in similar salt solutions.

As to the difference in kind and in degree of the concentration of salts within and without a membrane, all through the life of a human being the red blood corpuscles circulate in a medium rich in sodium and poor in potassium, and yet themselves remain rich in potassium and poor in sodium. To maintain this relative difference in concentration a membrane would surely need to be impermeable, but, as Moore and Roaf said in 1908, if such a membrane thus imprisons the salts and prevents adjustments of concentration, how did the salts enter the prison?

Lapicque approves the general conclusion of Moore and Roaf that the ratio of concentrations of these ions within and without the living corpuscle depends upon a mobile equilibrium between cell constituents and surrounding liquid, and is not controlled by diffusion restricted by a semi permeable membrane. Hamburger's experiments have shown these corpuscles to be very permeable to salts, so that any change in the medium produces an exchange of inorganic solutes between the corpuscles and the medium. Hamburger continues to regard the corpuscles as surrounded by a semi-permeable membrane, so that the loss of hæmoglobin in solutions hypotonic beyond a certain degree is explained as due to the bursting of the membrane. Lapicque points out that these laked corpuscles still change in volume with change in salt concentration, just like the original red corpuscles, so that if the membrane is destroyed, some of the properties still remain which it was postulated to explain.

Hoagland and other American workers have recently provided in plant physiology equally puzzling data as to the distribution of inorganic ions within and

without the vacuolated cell. Using Valonia and Nitella, marine and fresh-water algæ forms respectively, which have large enough cells to enable the sap to be collected from individual cells, they supply grounds for thinking that certain inorganic ions, for example potassium, are mainly, if not entirely, in solution in the sap of the vacuole, and yet retain a concentration much higher than that in the outside solution. The case of chlorides is particularly remarkable. Nitella will absorb practically every trace of chloride from the external solution, and will remain alive in distilled water for sixteen days without giving up any detectable trace of chlorine to the water, although containing very appreciable quantities in the vacuole. Hoagland concludes that Nitella under normal conditions possesses uni-directional permeability with reference to chlorine and potassium (*Journ. Gen. Physiology*, 5, pp. 629-646, 1923).

Lapicque concludes that the simple doctrine of the semi-permeable membrane, as employed to explain the salt content and swelling properties of the living cell, will soon appear as inadequate as the astrological conception of the firmament which makes it a crystal vault studded with stars. He adumbrates as factors, in a more adequate explanation, the distribution of salts according to the Donnan equilibrium between a non-diffusible amphoteric colloid and an aqueous membrane, with the great sensitiveness of such an equilibrium to hydrogen ion concentration, and also the hydrophilic behaviour of lipoids, which varies with the proportion of cholesterin to fatty acids or to lecithin. In view also of the modification reported in mitochondria with changes in external medium, he suggests that account may have to be taken of the physiological rôle of these structures, at present almost exclusively studied by the cytologist. Finally, he points out that the protoplasm is the seat of continuous transformation of energy, and that the phenomena under consideration will not admit of solution in terms of a passive semi-permeable membrane. To this last point the supporters of the membrane may reply that they have always assumed that a living cell owes its semi-permeable properties to a living membrane.

Maori Ethnography.[1]

FOR more than half a century the New Zealand Institute has published in its Transactions a vast amount of valuable information upon all aspects of the history of a group of the most interesting islands in the world. In the earlier years of the Dominion few of the colonists were intimately acquainted with the native language, and fewer still could penetrate the veil that hides the thoughts and ideas of the Maori mind. Many of these ethnological contributions, therefore, are of doubtful reliability. They are, nevertheless, often quoted by anthropological writers in other countries who are unable to discriminate between the wheat and the chaff. After the New Zealand University, with its highly cultivated staffs in its various colleges, began to liberate on the colony graduates trained to careful observation and exposition, it was soon recognised that the scientific study of the native race was an undertaking of the utmost urgency, for the day was already far spent for the garnering of what remained of their rapidly vanishing traditions and beliefs.

New journals were therefore necessary for recording exclusively these anthropological data. The chief of these are the Journal of the Polynesian Society, the Bulletins of the Dominion Museum, and the Records of the Canterbury and Dunedin Museums. It is the tenth volume of the Dominion Museum Bulletins, by Mr. Elsdon Best, that now comes under notice. The author emphasises the qualifications with which any investigator of primitive peoples should be endowed. "No traveller," he says, "or he of short sojourns may delve into . . . the inner strata of the mentality of barbaric man. . . ." [The Maori] "ever closely shields his true religion" [and] ". . . his inner mentality from the inquisitive gaze and analytical probing of inquiring outsiders. . . . In order to open the pages of the inner life . . . of such folks it is highly necessary to gain his confidence. A long residence in their midst, a good knowledge of their language. A quiet and non-critical bearing; a heartfelt sympathy with the feelings and prejudices of the people."

Just such are the qualifications possessed by the author, and consequently he has attained to the position of one of the most trustworthy interpreters of Maori psychology, and one of the highest authorities on their customs and beliefs.

The section of the Bulletin we have before us, a closely printed report of 264 pages, incorporates a vast amount of new and valuable, but not easily compressible, matter. It is impossible to do more than summarise its parts (as Mr. Best superscribes his chapters). An introductory part deals with the definition, origin, and development of religion preliminary to a comparison with Maori religion: the second surveys Maori religion and mythology from the evidence of early writers. On this follows a lengthy account of Maori cosmogony, theogeny, and anthropogeny, and further, by a classification of their gods, correcting the mistakes of several ethnologists who have misunderstood the term god as applied to the Maori religion. The New Zealand natives, above all the Polynesians of the Pacific, recognise a supreme divinity—Io—possessing divine attributes more nearly akin to the European idea of godhead. Part five deals with the offerings, human sacrifices, and images by which their spiritual beings can be influenced. This is succeeded by 28 specially interesting pages on the functions of the priests, the sacred places, and divination. Many ethnologists will read with surprise the singular fact that the village latrine was a *tuaha* or sacred place. *Tuaha* is the word "applied to any place where men's hair is cut, where tapu food is cast away or offered to supernatural beings," . . . and where "rites connected with many matters were conducted." The final part is concerned with an explanation of Maori ritual performances and formulæ—karakia—"a survey of native mentality and its effects as seen in the performance of rites connected with religion and magic," the numerous particulars of which "would require a chapter of cumbrous length." Mr. Best tells us, and so in the present Bulletin he can supply only a few illustrations. His work "The Maori," just about to be published, will, we hope, supply anthropologists with fuller details.

One suggestion may perhaps be permitted, that the numerous ritual formulæ quoted in the native language throughout the book and in several pages of addenda, might, if impossible of verbatim translation, be paraphrased to afford the reader, unacquainted with Maori speech, a general idea of their meaning. This monograph is of exceptional importance. So doubtless will be the second section, which will include a description of Maori magic and many illustrations of native myths and folk-tales.

[1] Maori Religion: Being an account of the Cosmogony, Anthropogeny, Religious Beliefs and Rites, Magic, and Folk-lore of the Maori Folk of New Zealand. Bulletin No. 10, Section 1. By Elsdon Best. (Dominion Museum, Wellington, N.Z., 1924.)

University and Educational Intelligence.

ABERDEEN.—At the summer graduation the honorary degree of LL.D. was conferred on Dr. J. J. R. MacLeod, professor of physiology at the University of Toronto.

The degree of D.Sc. was obtained by R. S. Clark for a thesis entitled "Rays and Skates" and by W. O. Kermack for a thesis entitled "Investigations of the Synthesis and Reactions of Indole Compounds."

BELFAST.—At the meeting of the Senate of the Queen's University held on July 15, a tender was accepted for the erection of buildings for the Department of Agriculture. It is hoped that these buildings will be completed in about 18 months at a cost of 46,000*l*. Of this sum, 34,500*l*. has been given by the Ministry of Agriculture for Northern Ireland, 5000*l*. was contributed by the late Miss Riddell, and 6000*l*. was provided from general University funds.

Applications are invited from British subjects for the Musgrave research studentship in physiology, value 190*l*. Particulars and application forms are obtainable from the secretary of the Queen's University.

BIRMINGHAM.—The following doctorates have been awarded: D.Sc.—W. E. Garner, for papers on gaseous explosions, heats of formation, detonation, crystallisation of organic substances, and other chemical subjects; J. D. Morgan, for papers on the ignition of explosive gases, and flame movements in gaseous explosions; and D. R. Nanji, for papers on chemical and biochemical subjects, mainly on the constitution of starch and the action of enzymes.

CAMBRIDGE.—Sir W. B. Hardy, Gonville and Caius College, and Dr. L. E. Shore, St. John's College, have been reappointed as University lecturers in physiology. Dr. E. K. Rideal, Trinity Hall, has been reappointed as Humphry Owen Jones lecturer in physical chemistry. The Wrenbury scholarship in economics has been awarded to H. C. B. Mynors, Corpus Christi College.

The following have been appointed Henry P. Davison scholars for the year 1925–26: H. H. Thomas, Sidney Sussex College, to Yale University; W. P. N. Edwards, Corpus Christi College, to Princeton University; and G. R. C. Eley, Trinity College, to Harvard University.

LONDON.—The following doctorates have been conferred: D.Sc. (in Chemistry) on Mr. Samuel Glasstone (King's College), for a thesis entitled "Studies of Electrolytic Polarisation"; and D.Sc. (Engineering) on Mr. R. G. Jakeman, for a thesis entitled "Alternating Current Wave-Windings," and other papers.

The University Studentship in Physiology for 1925–1926, of the value of 50*l*. and tenable for one year in a Physiological Laboratory of the University or of a School of the University, has been awarded to Dr. Isaac Cohen, who proposes to carry out research on tethelin under the direction of Prof. E. C. Dodds at the Bland-Sutton Institute of Pathology at the Middlesex Hospital Medical School.

The following are among the awards of the newly instituted University Postgraduate Studentships recently made: Travelling Studentships (value 275*l*.) to Mr. Reginald Percy Austin and Miss Helga Sharpe Pearson. Mr. Austin proposes to study archæology at the British School of Archæology, Athens, and to undertake excavations. Miss Pearson obtained the M.Sc. degree in zoology in 1924 (University College). She proposes to work on early Tertiary mammals in the continental museums among which this material is scattered.

ST. ANDREWS.—Mr. S. R. Kirk, assistant in geology, and Mr. John Williamson, assistant in mathematics, have submitted their resignations on appointment to the new Commonwealth Fund Fellowships, under which British students are enabled to carry on research work for two years in the United States. Six out of the total number of twenty fellowships available in the first year of the institution of the scheme have been awarded to the University of St. Andrews.

Principal John Yule Mackay has resigned the chair of anatomy in University College, Dundee, although he continues to hold office as Principal of the College.

SHEFFIELD.—The University Council has made the following appointments: Mr. I. C. F. Statham, to the chair of mining; Mr. N. M. H. Lightfoot, to be assistant lecturer in mathematics; Mr. Joseph Jenkins, to be assistant lecturer in civil engineering; Miss Esther Lowe, to be assistant in Zoological Department.

THE Busk Studentship in Aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 whilst flying an experimental aeroplane, has been awarded for the year 1925–26 to Mr. Stewart Scott Hall, of the Imperial College of Science, London.

BY the will of Sir Rickman Godlee, Bart., who died on April 20, the sum of 10,000*l*. is bequeathed, after his wife's death, upon trust for investment, the income to provide travelling scholarships for students of University College Hospital Medical School, London, who have held a resident appointment in University College Hospital. The ultimate residue of the estate is to be divided equally between University College, London, and University College Hospital, unless the latter is taken over by a public authority, in which event the whole will go to University College.

ROBERT BLAIR fellowships for this year have been awarded by the London County Council to Mr. N. P. Inglis and to Mr. A. B. Miller. The fellowships, which are worth 450*l*. each, are for one year's study abroad. Mr. Inglis, who is a fellow in the University of Liverpool, proposes to continue his studies on the fatigue of metals. Mr. Miller proposes to investigate the metal construction of aircraft with special reference to the materials employed and method of production.

THE Ramsay Memorial Fellowship Trustees have made the following awards for the session 1925–26, the place at which research is to be carried out being indicated in brackets: British Fellowships of 300*l*. to Mr. G. A. Elliott for two years (University College, London), and to Dr. H. R. Ing for one year (University of Manchester); Glasgow Fellowships of 300*l*. to Mr. T. C. Mitchell for two years (University of Cambridge); to Mr. J. D. Fulton for one year (University of Manchester); Canadian Fellowship to Dr. D. McKay Morrison (University of Cambridge); Japanese Fellowship of the value of 370*l*. to Dr. Seisi Takagi (University College, London). The following Fellowships have been renewed: Dr. S. W. Saunders (British Fellowship, University College, London); Mr. Kai J. Pedersen (Danish Fellowship, University of Bristol); M. M. Mathieu (French Fellowship, Davy Faraday Laboratory, Royal Institution, London); Dr. Nicolas Oeconomopoulos (Greek Fellowship, University College, London). Sir Robert Waley-Cohen has been appointed a Trustee of the Ramsay Memorial Fellowship Trust, in succession to the late Sir George Beilby.

Early Science at Oxford.

July 28, 1685. Mr. President presented ye Society with a Copy of his Algebra lately printed.

A letter from Mr. Aston dated July 23 was read; with it came Hevelius's *Annus Climactericus* presented to this Society by ye Royall Society.

Four Mathematicall papers drawn up by Mr Tolet, were presented ye Society: three of these papers were concerning gunnery, and ye finding altitudes. the fourth mentioned a controversy between Mr Tolet and Mr. Hern, concerning ye scituation of ye lines of Longitude; ye former affirming, that ye line of Longitude lies North and South, and ye line of Latitude East and West: ye latter affirmes that ye line of Longitude lies East and West, and ye line of Latitude North and South. Concerning which controversy Mr Hern having appealed to ye Royal Society at London, and to this at Oxford for a determination; this Society on ye account of Mr. Hern's appeal, and at the request of Mr. Ash Secretary of ye Dublin Society gives their opinion, which is this; They conceive it has been generally received among mathematicians, that ye lines of Longitude ly North and South, and ye lines of Latitude East and West.

These papers gave occasion to some discourse concerning the motion of Projecta; it was thought not improbable both by Mr. President & Mr. Caswell, that the Air does make a greater resistance against quicker bodies, than against those, which are slower, *cæteris paribus*.

A Letter from Mr. Cole of Bristoll dated July 18 and correcting a mistake in a former letter of his concerning ye measure of a Virginia Catskin in his custody, was read.

A Letter from Mr. Ash dated Trin: Coll (Dublin) July ye 12th was communicated and read; it contain'd a letter of Sr R. Buckley's, which gave a full description of ye new Calesh used by him: this last letter is sent ye Royal Society.

Dr. Plot proved, that not onely Box of ye English woods sinks in water; for Elder, if you cut off ye pith & the rind, does ye same, as we saw; ye black Walnut of Virginia was seen to sink

The measure of the hand of a monstrous Irish man, shewn lately at Oxford, was communicated by Dr. Plot: He was 7 foot 6 inches high, ye length of his span 14 inches, of his Cubit 2 foot 2 inches; of his Arm 3 foot 2 inches ½, from ye shoulder to ye crown of his head 11¾. His name Edmund Melloon, aged 19 years Anno 1684, born at Port Leicester in Meath. Upon this occasion Dr. Plot discoursed on ye extravagant proportion of parts in men of an extraordinary size, especially after sicknesse: concerning which he was desired to draw up his thoughts against ye next meeting.

July 29, 1684. An Account was brought in, of ye Ecclipse of ye Sun, on July 2, 1684; ye Observations were taken in ye University Observatory, by Dr. Wallis, Mr. Bernard, Mr. Caswell, and Mr. Rooke.

Dr. Plot presented ye Society with an Elf Arrow, brought from within two, or three, miles of Edinborough, where they are in great plenty. He shewed also some naturall gold of Scotland in a pepin, or great grain, and he also communicated an account of Black Lead found onely in Keswick in Cumberland, and there called Wadt, or Kellow.

Mr. Musgrave acquainted ye Society, that he had lately repeated ye experiment mentioned in ye Minutes of June 24th. 1684, tying and cutting of, ye externall Jugulars of a dog, with ye same success as formerly; ye dog in neither of these experiments being any way concerned at ye stoppage of ye circulation in these veins.

Societies and Academies.

LONDON.

Geological Society, June 10.—L. R. **Cox**: The fauna of the basal shell-bed of the Portland Stone of the Isle of Portland. On the western coast of the Isle of Portland the basal bed of the Portland Stone is a highly fossiliferous shelly limestone, on the surface of which fossils weather out in an extremely good state of preservation. The specimens described were collected by Lieut.-Col. R. H. Cunnington and include about 80 species of mollusca, of which 18 lamellibranchs and 9 gastropods are new to science, and several others have not before been recorded from Great Britain.—H. L. **Hawkins**: Echinoidea from the Portland Stone and the Purbeck Beds. Before last year only one species ("*Echinobrissus*" *brodiei* Wright) was known from the Portland Stone. A species of *Hemicidaris* from the sands was the only other echinoid recognised in the British Portlandian. The work of Lieut.-Col. Cunnington has revealed three specimens of "*E.*" *brodiei* in the basement-bed of the Portland Stone (and one from the overlying Whit-Bed), and material for the study of four other species, with indication of a sixth. Prof. Hawkins has also found *Hemicidaris purbeckensis* Forbes in the Middle Purbeck Series of Durlston Bay, near Swanage, which was collected from that locality about 75 years ago but not since, and specimens of an apparently new form referable to "Pseudodiadema" *sensu latissimo*. The irregular distribution of echinoids in these and other Jurassic strata may be due to the known tendency of echinoids to live in restricted clusters (comprising several species of similar ecological quality), which seem to migrate wholesale in successive generations.—E. **Spencer**: On some occurrences of spherulitic siderite and other carbonates in sediments. The spherulites occur in association with fine-grained sediments of carbonaceous, muddy, or silty type, often with comminuted plant-tissue, and are fairly uniform in size locally. The deposits seem to be of freshwater origin and devoid of calcareous shelly remains; the carbonate material in most cases consists of nearly pure siderite. The occluded sediment is similar to that in which the spherulites are embedded; where "zoning" of the sediment occurs, it is subordinate to radial structure. The spherulites probably formed from iron-carbonate solutions held within the gradually settling and consolidating sediment. The reactions resulting from the presence in sediments of humate compounds, salt, calcium carbonate, etc., are considered. The iron compounds present in solution in fresh water were probably adsorbed by the fine-grained and partly colloidal sediments, and carried down with them during deposition. Supersaturation would result from the settling and flocculation of the sediment, and from the gradual upward expulsion of the more readily diffused water-molecules. Crystallisation would then commence at a number of centres simultaneously.

Optical Society, June 11.—E. F. **Fincham**: The changes in the form of the crystalline lens in accommodation. According to Helmholtz, the lens swells and increases in convexity during accommodation because the tension upon it is relaxed when the ciliary muscle contracts. In order to explain the change of the anterior surface of the lens to a hyperbolic form in accommodation, Tscherning states that the tension of the lens is maintained when the muscle contracts, and the forms of the surfaces are altered by a pressure by the vitreous humour exerted

upon the periphery of the posterior lens surface. The radii of curvature of both anterior and posterior surfaces of the lens, and also the movement which the apices of these surfaces make in accommodation, have now been measured. In two selected cases of men of the same age and having the same refractive error, considerable differences in the behaviour of the lens in accommodation were found. For a given amount of accommodation, whereas the lens surfaces in one case are more increased in curvature than in the other, their apices suffer less movement; the surface which was most altered in curvature showed the most pronounced hyperbolic form in both relaxed and accommodated conditions. The results can be explained by the Helmholtz theory, by taking into account the properties of the lens capsule.—C. V. **Raman** and K. **Banerji**: The optical properties of amethyst quartz. A section-plate of amethyst cut normal to the optic axis, when viewed under suitable conditions, without a polariser or analyser, shows coloured diffraction fringes of the Fresnel type, arranged periodically and running parallel to the lines of the structure. The diffraction effect is due to the periodic change of phase produced by the structure and not to any periodic variation of transparency. The diffraction spectra of the Fraunhofer type due to the structure may also be observed. The plate is thus in effect a phase-change diffraction grating.—R. S. **Clay** and T. H. **Court**: A Lucernal microscope by Samuel Washbourn, London. The instrument, which was probably made in 1800, has adjustments for focussing and for moving the object in two directions at right angles to one another. The objectives, consisting of single lenses, are mounted in a vertical slide so that different powers may be used. All the adjustments can be made from the eyepiece end. The instrument can readily be taken to pieces and the parts fit into a case, suggesting that it was originally used by a peripatetic lecturer.

Physical Society, June 12.—G. **Temple**: On mass and energy. It is assumed that variations in the potential energy of a body (gravitational or electrostatic) are always accompanied by proportionate changes in its mass. Continuing this assumption with the theories of Newtonian dynamics and Maxwellian electrodynamics, it has been found possible to predict all those phenomena, which are usually regarded as the crucial tests of the theories of relativity, both "special" and "general."—E. **Tyler** and E. G. **Richardson**: The characteristic curves of liquid jets. Continuing the work of S. W. J. Smith and H. Moss upon the relation between the length of a capillary jet and its velocity of efflux from a cylindrical orifice, further examination has been made of the causes to which the main features of the curves obtained by these authors are due. Such curves consist of two main branches. In the first, with increasing velocity, the jet length rises until a critical point is reached. In the second, which begins at this point, the jet length diminishes rapidly with further increase of velocity. The results now obtained indicate that, while surface tension is of prime importance in the first parts of these curves, viscosity is the dominating factor in the second.

Royal Statistical Society, June 16.—F. **Shirras**: Taxable capacity and the burden of taxation and public debt. The national income of Great Britain and Northern Ireland in 1924 is estimated at 3850 millions sterling. At the end of 1919 it was between 4000 and 5000 millions sterling. The national income of France for 1924 is estimated at 164 milliard francs; of Germany, for the end of 1924, at least 30 milliards of gold marks; of the United States in 1924, 60,000 million dollars. Taking the percentage of taxation to the total net income the following figures are for 1923 or 1924, those in brackets being the pre-War year figures: Germany, 26 per cent. (11·8 per cent.); Great Britain and Northern Ireland, 22·1 (11·4); Japan, 21·8 (18·2); Canada, 19·2 (13); Australia, 18·4 (10·4); France, 17·8 (13·8); Austria, pre-War, 15 per cent., and the 1924 figure indicates that taxation is probably heavier than before the War; United States, 10·5 (6·5); and India, 5·1 (4·4).

DUBLIN.

Royal Irish Academy, June 8.—J. J. **Nolan** and J. **Enright**. Preliminary account of observations on the size of raindrops. Raindrops of radii from 2 to $45 \cdot 10^{-3}$ cm. have been accurately measured. This range covers the interval between the observations of Defant on raindrops and those of Köhler on mist-particles. The smaller drops are found in very great numbers. Certain sizes appear to be specially prominent, but further observations are necessary to test the reality of this prominence.

EDINBURGH.

Royal Society, June 8.—Sir Alfred **Ewing**. A ball and tube flow-meter. The device provides a visible measure of the rate of flow of a liquid through any pipe system without interfering with the flow. It consists of a slightly tapered, straight glass tube to which a scale is attached. Within the tube is a ball which is a loose fit at the bottom, and round which there is a considerable clearance as the ball is forced up in the tube. The tube is placed in a sloping position with the narrow end down, and the liquid flows up towards the wider end. The stream carries the ball up along the tube until a position is reached where the clearance round the ball is such as to suit the particular rate of flow. The position of the ball is read off on the scale, and from that position the rate of flow is determined. The sustaining action of the moving stream upon the ball is due to two causes: an inertia effect caused by the development of turbulence in the region above the ball, and an effect of viscosity by which the stream produces an upward drag in passing over the ball. By experiments with two fluids the relative magnitude of the two effects was determined. The device is being adapted by the Engineering Committee of the Food Investigation Board to indicate the circulation of the working fluid in the cycle of a refrigerating machine.—Général **Ferrié**: Maintenance of clocks by means of photoelectric cells. The pendulum to be maintained in oscillation is mechanically entirely free. A small mirror is attached near the top of the rod and a permanent horseshoe magnet to the foot. Light falling on the mirror is reflected in the vertical position of the pendulum to a photoelectric cell. The electron current is amplified, and passes round a solenoid which engages one arm of the horseshoe magnet attached to the pendulum in a suitable position, and maintains the motion. Complete syntony is thus realised.—W. **Peddie**: A spectrometer designed specially for investigations regarding colour vision. A single slit is used and the collimator lens, being divided into halves diametrally, gives two images which are formed on a diffusion plate and so act as the two slits with a single source. A second split lens parallelises the light from these images and gives, by suitable sliding of the halves,

on passage through a prism and an object glass of a telescope, four partially superposed spectra, two of which can be exactly superposed. A slit at the focus of the telescope allows a portion of the three independent spectra to pass through, and the wave-lengths transmitted may be adjusted suitably for compounding red, green, and blue lights. With weaker illumination the diffusion plate is omitted and a biprism is placed behind each half of the second split lens.—J. **Forrest**: A new method of discriminating the arrangement of the molecules in a crystal. High magnetic fields are used. Theory gives an estimate of the variations of the internal magnetic force in a crystal when the external magnetising field takes all possible orientations about the substance, which is regarded as composed of a regular array of molecular magnets. The components of force parallel and transverse to the field are dealt with, and positions of maxima and minima of these are predicted in any convenient plane of the crystal for any possible lattice arrangement of the centres. Some weakly magnetic crystals were investigated experimentally and give good agreement with the results of X-ray measurements. Different lattices can be compared with respect to their stability, dealing with the internal magnetic energy of regular arrangements of molecular magnets which are co-directed or randomly oriented.—D. A. **Fairweather**: The electrosynthesis of *n* duotriacontane dicarboxylic acid. This acid, containing a chain of thirty-four carbon atoms, is the highest member of the series of normal dibasic acids so far prepared. Its di-ester was obtained by electrolysis of sodium ethyl hexadecane dicarboxylate. W. L. **Ferrar**: On the cardinal function of interpolation theory. The relation of the series defining the function with other types of expansion is considered; in particular, its relation with the Gauss formula. The convergence of the latter implies the summability of the former (by de la Vallée Poussin's method) to the same sum.

PARIS.

Academy of Sciences, June 22.—G. **Bigourdan**: The systematic errors which may affect the pendulum corrections employed at the B.I.H.—V. **Grignard** and R. **Escourrou**: The catalytic hydrogenation of the nitriles under reduced pressure. A method for the synthesis of the aldimines. The activity of the catalyst is reduced by working under reduced pressure. With oxide of platinum on pumice as catalyst, at 200° C. and under a pressure of 220 mm., benzyl cyanide is completely reduced to the aldimine $C_6H_5CH_2$ CH—NH at one passage. Benzonitrile undergoes a similar reduction.—C. **Sauvageau**: The naturalisation in France of the Australian *Asparagopsis armata*. Its iodine reserves. There would appear to be some free iodine in this plant.—Léon Guillet was elected a member of the division of the applications of science to industry in succession to the late Charles Rabut.—J. **Haag**. Certain asymptotic probabilities.—C. **Valiron**: Meromorph functions which are exceptional relatively to the theorem of M. Julia.—V. **Romanovsky**: Certain mathematical expectations and on the mean error of the coefficient of correlation.—E. **Huguenard**, A. **Magnan**, and A. **Planiol**: A method of studying the inertia effects resulting from the operations of steering aeroplanes.—A. **Lafay**: The deviations of the thrust of the wind, on a cylinder, produced by a sheet of air impinging tangentially to the surface of this body.—F. **Zerner**: The entanglement of the ether and the aberration of the stars.—P. **Chofardet**: Observations of the Tempel II. comet (1925*d*, Stobbe) made at the Besançon Observatory with the 33-cm. equatorial. Positions of the comet and comparison stars are given for June 15, 16, 18, 19. It was seen as a rounded nebulosity of about the 12th magnitude with a small central nucleus.—G. **Rougier**: Observations of the Tempel II comet (1925*d*) made with the 40-cm. equatorial of the Observatory of Strasbourg. Position given for June 16.—Mlle. **Bérenger** and A. **Tian**: Heats of solution and heats of incomplete reactions.—C. **Gutton** and E. **Pierret**: The harmonics of oscillators with very short waves.—G. **Foex** and L. **Royer**: The diamagnetism of nematic substances.—A. **Dufour**: The classical calculation of the Michelson experiment on the hypothesis of an immobile ether.—Mlle. J. **Liquier**: The variation of the rotatory power of solutions of asparagine as a function of the hydrogen ion concentration. Whatever acid be added the rotation is the same for a given hydrogen ion concentration. On the hypothesis that there is present a mixture of non-dissociated molecules and the corresponding ions, the rotatory power can be expressed quantitatively as a function of the hydrogen ion concentration and the two dissociation constants of asparagine. The theoretical curve so derived coincides closely with the experimental figures.—Th. **Vautier**: The secondary waves produced by an aerial wave. Th. de **Donder**: The calculation of specific affinity. Jean **Barbaudy**: The boiling-points of mixtures of water, benzene, and ethyl alcohol under a pressure of 760 mm. of mercury. The whole of the experimental results are shown on a triangular diagram. The minimum boiling point given by Young is confirmed.—P. **Chevenard**: The dilatometric anomaly of the α solid solutions of copper and aluminium.—T. **Batuecas**: Revision of the weight of the normal litre of methyl chloride gas. The methyl chloride was prepared by two independent methods, the interaction of phosphorus trichloride and methyl alcohol and by the pyrogenic decomposition of tetramethylammonium chloride. The mean of seventeen determinations is 2·3084, appreciably greater than the value given by G. Baume, 2·3045.—P. **Job**: The spectrographic study of the formation of mercuric complexes.—E. **Rouyer**. The association of the polyphenols. J. **Bardet** and C. **Toussaint**: The separation of celtium, and the arc spectrum of this element. In the separation of zirconium and celtium a good method can be based on the difference of the solubility of the phosphates in sulphuric acid.—Pierre **Auger**: The experimental study of the directions of emission of the photo-electrons.—N. **Delbart**: Study of the corrosion of cold drawn steels in sulphuric acid of varying degrees of concentration.—J. **Bougault**: Phenyl-α-oxycrotonamide. An example of ether-oxide of the hydrate of a ketone.—Charles **Dufraisse** and Henri **Moureu**: Phenylbenzylglyoxal.—R. **Weil**: The microscopic study of the αβ transformation of natural cristobalite.—Pierre **Sève**: An arrangement for measuring the optical constants of crystals in the ultra-violet.—L. **Cayeux**: The existence of diatoms in the millstone grit in the neighbourhood of Paris. The organic origin of the silica.—Ch. **Maurain**, E. **Salles**, and G. **Gibault**: The conductivity and electric currents of the atmosphere.—René **Souèges**: The embryogeny of the Rutaceæ. Development of the embryo in *Ruta graveolens*.—Ad. Davy de **Virville**: The action of light on the mosses. The appearance, size, colour, form, and structure of the mosses are modified by the intensity of the light to which they are exposed. With diminution or suppression of the light, the distinctive characters from which several species take their names disappear.—Mlle. France **Gueylord** and P. **Portier**: The ionic reaction

of the different constituents of the egg of the fowl. Its modifications in the course of incubation. In the early stages of incubation the white is alkaline (P_H 8) and the yolk is acid (P_H 5·5). In the course of development the reactions of the two constituents converge towards neutrality, which is reached on the tenth day.—J. **Nageotte**: The morphology of striated muscle in a state of chloroform contraction, in the frog.—E. **Kayer** and H. **Delaval**: Contribution to the clarification of apple musts.—Maurice **Nicloux** and Jean **Roche**: The amount of oxygen in methæmoglobin. New experiments confirming the views of G. Quagliariello, that the oxygen in methæmoglobin is half that in oxyhæmoglobin.—C. **Levaditi**: The curative action of basic bismuth acetyloxyaminophenylarsinate in experimental syphilis. Stovarsol mixed with an aqueous solution of sodium and potassium bismutho-tartrate forms a new compound $(OH)(NH.CO.CH_3)C_6H_3.AsO_3H - Bi(OH)_2$. In oil suspension this compound cures experimental syphilis in the rabbit.—L. **Fournier** and A. **Schwartz**: The curative action of basic bismuth acetyloxyaminophenylarsinate in syphilis. An account of the treatment of twenty cases of syphilis with the compound described in the preceding communication. The injections cause none of the inconveniences usual with the ordinary bismuth treatment: the curative effect is as rapid as any of the best antisyphilitic preparations.

ROME.

Royal Academy of the Lincei, April 19.—Guido **Fubini**: The modular group in four-dimensional space.—O. M. **Corbino** and E. **Persico**: The oscillating current diagram.—N. **Parravano** and G. **Malquori**: Solubility of oxygen in silver. Absorption of oxygen by molten silver is very slow, and is complete only after some days. The velocity of absorption appears to be a function of the velocity with which the gas diffuses into the interior of the metal.—Secondo **Franchi**: The great variety of the lithological complexes of the metamorphic Trias of the Western Alps.—A. **Carrelli**: Tyndall's phenomenon.—P. **Bertolo**: Genesis of artemisic acid from desmotroposantonin.—L. **Fernandes**: Co-ordination valency of two hydroxyl groups in the ortho position. I. Complexes of pyrocatechol and pyrogallol with acids of the molybdenum group.—P. **Leone**: Metallo-organic compounds of aluminium. IV. Action of chlorides of acid radicles. The action of benzoyl chloride on aluminium ethyl iodide in ethereal solution yields αα-dibenzoylethane, together with a very small proportion of propiophenone; ethane is also liberated, probably as a result of decomposition of the aluminium ethyl iodide by the hydrochloric acid formed during the condensation.—G. **Malquori**: Thermal behaviour of hydrated barium aluminates. Barium aluminate, $BaAl_2O_4.5H_2O$, prepared by dissolving the calculated amount of alumina in boiling saturated baryta solution, loses $3H_2O$ at 190° and $5H_2O$ at 310°, and shows breaks in the heating-curve at 725° and 1040°, corresponding with decompositions of the compound.—Carlo **Sandonnini**: Certain physico-chemical properties of mixtures of water and acetone. The variation of surface tension, heat of mixing, specific heat, and viscosity of water-acetone mixtures with the composition renders probable the existence of complex molecules of the two compounds.—E. **Remotti**: The immediate physical factors which may co-operate in determining the vertical migrations of fishes.—Enrico **Sereni**: Certain peculiarities of the action of sodium chloride on the muscles of frogs.

Official Publications Received.

Report for 1924 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel. Edited by Prof. James Johnstone. Pp. 136. (Liverpool.)

Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Limited, Turner's Hill, Cheshunt, Herts. Tenth Annual Report, 1924. Pp. 104. (Cheshunt.)

Meteorological Office: Air Ministry. Advisory Committee on Atmospheric Pollution. Report on Observations in the Year ending March 31st, 1924: Forming the Tenth Report of the Committee for the Investigation of Atmospheric Pollution. (M.O. 270.) Pp. 58. (London: H.M. Stationery Office.) 4s. net.

Annual Conference of the Universities of Great Britain and Ireland, 1925. Report of Proceedings. Pp. 60. (London: Universities Bureau of the British Empire.) 1s.

Conseil Permanent International pour l'Exploration de la Mer. Publications de Circonstance No. 86: A Recording Current Meter. By H. J. Buchanan-Wollaston. Pp. 14. Publications de Circonstance No. 87: L'emploi de l'eau normale dans l'océanographie. Par Martin Knudsen. Pp. 11. (Copenhague: Andr. Fred. Host et fils.)

Proceedings of the Royal Society of Edinburgh, Session 1924-1925. Vol. 45, Part 3, No. 21: Rejuvenation of the Aged Fowl through Thyroid Medication. By F. A. E. Crew. Pp. 252-260. Vol. 45, Part 3, No. 22: L'Entretien des pendules au moyen de cellules photo-électriques. Par M. le General G. Ferrie. Pp. 261-268. (Edinburgh: R. Grant and Son; London: Williams and Norgate, Ltd.) 1s. each.

Forestry Commission. Fifth Annual Report of the Forestry Commissioners, Year ending September 30th, 1924. Pp. 43. (London: H.M. Stationery Office.) 1s. net.

The Society for Promoting Scientific Knowledge. A Review of Activities during 25 years 1900-1925, and Twenty-fifth Annual Report. Pp. 46. (Lahore.)

United States Department of Agriculture. Department Bulletin No. 1328: The Flight Activities of the Honeybee. By A. E. Lundie. Pp. 38. 10 cents. Department Bulletin No. 1332: Emulsions of Wormseed Oil and of Carbon Disulfide for destroying Larvæ of the Japanese Beetle in the Roots of Perennial Plants. By B. R. Leach and J. P. Johnson. Pp. 18. 5 cents. (Washington: Government Printing Office.)

New South Wales: Department of Mines: Geological Survey. Bulletin No. 6: The Coal Resources of New South Wales. By the Staff of the Geological Survey. Pp. 154+12 plates. 6d. Bulletin No. 9: Limestone, Dolomite, Lime, and Hydraulic Cement. By Leo J. Jones. Pp. 37+7 plates. 3s. 6d. Bulletin No. 10: Barytes, Ochres, and Oxides. By H. G. Raggatt. Pp. 10+2 plates. 1s. (Sydney: Alfred James Kent.)

Memoirs of the Indian Museum. Vol. 8, No. 2: Revision of the Indian Ampullariidae. By Dr. B. Prashad. Pp. 69-89+plates 13-15. (Calcutta: Zoological Survey of India.) 3 rupees.

Aeronautical Research Committee. Reports and Memoranda, No. 962 (Ae. 178): Discontinuous Flow around the Edge of a Bluff Obstacle. By L. W. Bryant and D. H. Williams. (A.1.b. Photographic Work, etc., 9. T.2908.) Pp. 4+11 plates. (London: H.M. Stationery Office.) 1s. net.

Cornell University Agricultural Experiment Station. Memoir 68: The Lepidoptera of New York and neighboring States; Primitive Forms, Microlepidoptera, Pyraloids, Bombyces. By William T. M. Forbes. Pp. 729. (Ithaca, N.Y.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 58: The Survival of Pink Boll Worm Larvæ in Buried Seed during the Winter in Egypt. By C. B. Williams and Ibrahim Effl. Bishara. Pp. 7+2 plates. (Cairo: Government Publications Office.) 5 P.T.

Report of the Aeronautical Research Institute, Tokyo Imperial University. Vol. 1, No. 10: The Inertia Forces and Couples and their Balancing of the Star Type Engine. By Keikichi Tanaka. Pp. 247-304. (Tokyo: Maruzen Kabushiki-Kaisha.) 1.10 yen.

Field Museum of Natural History. Botanical Series, Vol. 4, No. 4: South American Plants, by J. Francis MacBride; also New Euphorbias, by C. F. Millspaugh, and Canavalias, by C. V. Piper. (Publication 231.) Pp. 79-95. (Chicago.)

A Cotton Research Station for the British Empire: Being a Summary of a Report to the Empire Cotton Growing Corporation. By Prof. J. B. Farmer and L. G. Kilby. Pp. 23. (London: Empire Cotton Growing Corporation.)

The Faraday Society. Report of the Council and Statement of Accounts to be presented at the Annual General Meeting, July 6th, 1925. Pp. 11. (London: The Faraday Society.)

Smithsonian Miscellaneous Collections. Vol. 75, No. 3: Cambrian Geology and Paleontology, V. No. 3: Cambrian and Ozarkian Trilobites. By Charles D. Walcott. (Publication 2823.) Pp. 59-146+plates 15-24. (Washington: Smithsonian Institution.)

Diary of Societies.

SATURDAY, JULY 25.

ARISTOTELIAN SOCIETY, MIND ASSOCIATION, AND OXFORD PHILOSOPHICAL SOCIETY (Joint Session) (at Balliol College, Oxford), at 10 A.M.—C. R. Morris, Dr. Dorothy Wrinch, and Prof. L. J. Russell: Symposium: The Concept of Energy.—At 2.30.—Dr. Ivy Mackenzie: The Biological Basis of the Sense of Time.—At 8.30.—Prof. J. A. Smith, Prof. A. D. Lindsay, and Dr. F. C. S. Schiller: Symposium: Croce's Theory of the Practical Nature of Science.

SUNDAY, JULY 26.

ARISTOTELIAN SOCIETY, MIND ASSOCIATION, AND OXFORD PHILOSOPHICAL SOCIETY (Joint Session) (at Balliol College, Oxford), at 2.30.—P. E. More, Prof. W. D. Ross, and Prof. G. Dawes Hicks: Symposium: Plato and Aristotle.—At 8.30.—J. MacMurray, C. E. M. Joad, and A. H. Hannay: Symposium: Is Art a form of Expression or of Apprehension?

MONDAY, JULY 27.

CAMBRIDGE PHILOSOPHICAL SOCIETY, at 4.30.

SATURDAY, AUGUST 1, 1925.

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The Future of the British Patent Office.

II.

IN investigating in Great Britain the novelty of an invention, the Patent Office confines its search to British specifications published within the previous fifty years, and we have suggested that the search should be extended to cover text-books, periodicals, and foreign specifications, the period of search being restricted to twenty years except in the case of British specifications and text-books. The foreign specifications to be considered would be those published in the Dominions, France, Belgium, Germany, the United States, and Switzerland, for few inventions of serious importance will fail to be protected in one or other of these countries. We have now to estimate the increase of staff and of cost which this innovation would involve, and to show that the expense can be met by practicable means.

The machinery for the present search amongst British specifications was evolved by the scientific section of the Patent Office staff after many trials, and its success suggests that the devising of extended machinery must be left in the same hands. In order, however, to estimate what is involved in the present proposals, it will be necessary to consider in outline the form which that machinery would probably take. The characteristic feature to which the British search owes its thoroughness is the use of abridgments, so that the first step would be the abridging of the specifications published within the prescribed period in the countries we have mentioned, with the exception of New Zealand, Australia, and Belgium, for which countries abridgments are already available. Since the same inventor will often protect his invention in several different countries, many duplicates will be found: in order to sort these out and bring them together, by the aid of the inventor's name, the title, and the general aspect of the drawings, a small clerical staff would be necessary. For the actual work of abridging specifications in French and German the use of translators is to be deprecated, for it is both uneconomical and unsatisfactory in its results. Each class of subject-matter should preferably be indexed and abridged by the examiner, or syndicate of examiners, familiar with that class, so that it will be necessary for each syndicate to contain some one familiar with French and German. This should not be difficult, since most scientific men already know at least one of these languages.

As regards literature, text-books and year-books present little difficulty as they are usually provided with indexes, and examiners would soon become familiar with those which relate to their particular classes. Weekly and monthly periodicals and irregular publications such as bulletins are, with few exceptions, devoted

to a very restricted range of subject-matter: the examiner concerned with any such periodical would make extracts from it for his card index, the shorter extracts by means of manuscript notes and the longer extracts by means of underlined press-cuttings. The more general periodicals would have to be circulated to a number of examiners, but in most cases it would be sufficient to arrange that a single primary examiner should read each issue, passing on to the appropriate colleague any subject-matter for which he could not himself account satisfactorily.

We have now to estimate the increase in staff which would be necessary in order to carry out a search of the extent and thoroughness proposed. Let us consider first the state of things which will prevail when all preparatory work has been completed and only current work is being dealt with. We must compare the work of dealing with the specifications published annually in the countries we have mentioned with the annual work done on British specifications by the present staff, and for this purpose we shall assume that an examiner spends one-fifth of his time in abridging and indexing, one-fifth in actually searching, and the remaining three-fifths in general examination, attending to amendments, interviews, and provisional specifications, preparing for hearings, improving the classification of search material, studying law reports and technical literature, and other miscellaneous duties. We shall assume further that the time spent in reading, indexing, and abridging a specification would be halved in the case of foreign specifications, for since no general examination is to follow in their case, a far less meticulous reading would suffice than in the case of British applications; and we shall assume that the rate of searching could be increased by increasing the number of sub-headings under which inventions are classified. There are no statistics to support these assumptions and they are open to debate, but it can be said in their favour that they appear reasonable, and further, that the actual time spent in these tasks can be controlled, since the standard of thoroughness is necessarily somewhat arbitrary.

These assumptions, then, give us a measure of the additional staff necessary to abridge, index, and search through a given number of additional specifications, and we must turn next to the statistics of specifications published abroad. In doing so, however, we must allow for duplicates, for (to give only two examples) 65 per cent. of Canadian patents are granted to residents in the United States, 7 per cent. to residents in Great Britain, and only 16 per cent. to Canadians: while of British patents 58·5 per cent. are indigenous, 28·5 per cent. are granted to residents in the other countries we have mentioned, and the remaining 13 per cent. are granted to residents in Sweden, Holland, and other countries not mentioned. (These figures relate to the year 1922.) It is safe to assume that every applicant will have applied for a patent in his own country, so that in estimating the number of foreign specifications per annum we may eliminate duplicates by counting only indigenous patents. The resulting figure will be a little too small, but sufficiently accurate for our present purpose. The latest complete statistics are for the years 1921 and 1922, and taking the mean of these two years as a basis, the annual output of unabridged indigenous published specifications is as follows: Canada 1610, South Africa (estimated) 340, India 263, France 10,394, Germany (estimated) 14,500, United States 33,941, Switzerland 1907, total 62,955. This total we must compare with the mean number of specifications abridged annually by the present examining staff during the same period. This figure is not accurately known, as not all specifications which have been abridged are published, but it cannot be far short of 19,000. At this rate the new material to be abridged annually will be about 3·3 times the material at present abridged annually, so that on the basis already explained we must increase the staff by 33 per cent. on this account.

New Zealand publishes about 360 indigenous patents per annum, Australia 2600, and Belgium 6000, but as these are already abridged the work of indexing them, at the rate of about 1 per fortnight per examiner, need not be taken into account. As regards the time spent in searching amongst foreign patents, the search material would be increased by the specifications published in the countries mentioned during the previous twenty years, the total being about 1,750,000, but to allow for duplicates this must be reduced, in the general ratio of indigenous to total patents, to 1,250,000. The latter figure must be compared with the number of British patents at present in the search files and covering a period of fifty years: that number is about 550,000, so that the search material will be increased by about 228 per cent., and on the basis we have adopted this means a further increase of 23 per cent. in staff to allow for the extra time spent in searching.

As regards literature, we pass over text-books and year-books because, as has already been pointed out, the staff can take these in its stride. Of the 1759 weekly, monthly, and irregular periodicals taken by the Patent Office Library, a considerable proportion is devoted to non-patentable subject-matter. Of those which contain search material it has been estimated that there are very roughly 18,000 issues per annum, a number of the same order as the number of British specifications filed per annum. To determine the average content of an issue would require a very elaborate research, for some periodicals, such as papers on wireless, contain a good deal of subject-matter, while others, such as agricultural

papers, rarely contain any reference to invention, and mere quotations from specifications could, of course, be ignored. On the whole, we shall be fairly safe if we say that one average issue contains as much subject-matter as one average specification, and at this rate we must allow a further increase in staff of 10 per cent. on account of indexing periodicals and 7 per cent. on account of searching them for the past twenty years. This gives a total increase of 73 per cent. in the staff, if we make no allowance for time to be spent in visiting factories.

We turn next to the preparatory period which must elapse before a universal search could be undertaken. The preparatory work would include (1) the improvement of the classification by increasing the number of headings; (2) the training of the new staff and reorganisation of the staff as a whole; (3) the abridging and indexing of the periodicals and foreign specifications published during past years. The last item is the most serious, and is the only one which we shall take into consideration here. If merely the additional 73 per cent. of staff were to be engaged some time before the institution of the search for the purpose of carrying out the work of preparation, there would be a delay of 12 years before the search could begin; so that in addition to increasing the establishment by 73 per cent. it would be necessary, in order to shorten this delay, to engage a temporary excess of, say, 23 per cent. of the then establishment. This would enable a search to be begun five years after the engagement of the new staff and covering a period of thirteen years: three and a half years later the full period of twenty years could be searched, and there would then be a redundant staff of 23 per cent., which would be absorbed by normal wastage in six or seven years. If a larger excess staff were engaged in the first instance the search could be undertaken at still shorter notice, but the capital cost would, of course, be increased. Against this capital cost must be set off, in any case, the saving due to the fact that the new staff would enter the office on the lowest rung of their salary scale.

Great Britain is spending some 466,000,000*l.* in the relief of unemployment, largely by methods admittedly uneconomic. Little is being spent in the relief of unemployment by the stimulation of new manufactures: on the contrary, the inventor has to pay for the whole cost of the patent system and to pay upwards of 75,000*l.* a year in addition, in relief of general taxation, whereas in 1924, the United States thought it worth while to spend on her patent office 408,602 dollars out of her exchequer. These facts must be borne in mind in considering the question of the annual cost of the proposed extended search. The chief item will be the annual salaries of the additional staff, and we must estimate these not at the initial rate of salary at which new entrants will take up their duties, but at the average taken over their whole official career, which will be considerably higher. We may assume that this average will be equal to that for the present examining staff, so that if we take the aggregate salary of the latter, excluding Hearing Officers, and multiply it by 0·73, we shall arrive at the normal increase in annual expenditure on this account. The result, as estimated from the Comptroller's Report for 1924, amounts roughly to 106,400*l.* per annum, and to this we may add 3000*l.* for clerical and other supplementary staff, 5000*l.* for purchase of documents, and 7000*l.* for buildings, furniture, and maintenance, giving a total of 121,400*l.* per annum.

How is this additional expenditure to be met? We may put aside for the moment the suggestion that the whole cost of the patent system might be transferred to a tax on the sale of patented articles, and turn to more conventional sources of revenue. In the first place, the Patent Office makes a profit of 75,000*l.* a year. There is no justification whatever for this profit: it is a direct tax for the discouragement of invention, and only persists because it has been no one's business to attack it effectively. We may assume, then, that this profit can be abandoned, as the community's contribution to the cost of a scheme which is to benefit it considerably. Next, the maximum normal life of a patent might be extended to twenty years instead of the present sixteen. For the older patents the yield from renewal fees in respect of the nth year is given in pounds sterling by the formula $1{\cdot}7 \times 10^{5-0{\cdot}072n}$ with such accuracy that we may venture to extrapolate for the four years following. We thus find an additional yield of 32,000*l.* per annum from this source, leaving 14,400*l.* still to be found. As some 17,000 patents are sealed per annum, the addition of 1*l.* to the sealing fee is consequently the only increase in fees which would be necessary in order to balance the Patent Office budget.

In order to justify the preceding calculations it is necessary to examine rather carefully the effect of an increase in fees on the annual output of inventions. It may be supposed that such an increase will tend to diminish the output of inventions, while the enhanced value of the patent when granted will tend to augment it, so that some doubt arises as to the net effect. All experience goes to show, however, that a small change in fees has a negligible effect. When the present very limited British search was introduced in 1905 and at the same time the sealing fee of 1*l.* was added to the cost of the British patent, no change at all took place in the annual number of applications, while, on comparing the triennium 1902–4 with the triennium 1906–8, we find that the annual number of complete specifications increased by 17·5 per cent., and the annual number of

patents sealed increased by 6 per cent. In the United States the application fee was increased in 1922 from 15 dollars to 20 dollars, the final fee of 20 dollars remaining unchanged and no *quid pro quo* being offered by way of increased value in the patent: yet if we compare the preceding years 1919–21 with the following years 1923–4, we find that before the change the United States had 2·54 times as many applications as Great Britain, and after the change 2·50 times as many, a drop of only 1·6 per cent.

Then again, the scales of fees are very different in Great Britain, Germany, and the United States; yet the output of inventions per head of the population is roughly the same in each of these countries. Thus in Great Britain there is an application fee of 1*l.*, a "complete" fee of 3*l.*, and a sealing fee of 1*l.*, or a total initial fee of 5*l.*, followed by an increasing scale of renewal fees for the fifth and later years. In Germany there was until recently an application fee of 6 gold marks and an examination fee of 8 gold marks, or a total initial fee of 14 gold marks (about 14*s.*), followed by an increasing scale of renewal fees from the second year onwards. In the United States there is an application fee of 20 dollars and a final fee of 20 dollars, or a total of 40 dollars (8*l.*), but there are no renewal fees at all. It might be expected, therefore, that the output of specifications would be very different in the three countries, yet if we take the official figures on this subject for the year 1923 and compare them with the populations as given in the latest Whitaker's Almanack, we find the following result: Applications per thousand of the population in Great Britain, 0·69; in Germany, 0·75; in the United States, 0·76. Complete specifications filed per thousand of the population in Great Britain, 0·40; in Germany, 0·38; in the United States, 0·39. All these figures go to show that within reasonable limits fees have very little effect on the output of inventions.

Mr. Churchill has said that an overwhelming case can always be made out for doing nothing. To institute an extended search such as we have described would be a large undertaking, and one which is sure to encounter the opposition of a good deal of natural inertia. Yet at the present time the British patent system is like an unfinished house, and if the figures we have given are of the right order, there is no serious reason why it should not be provided with its roof. We have shown that if a substantially universal search be undertaken within five years, the Patent Office can still balance its annual budget without increase of fees, except for the addition of 1*l.* to the sealing fee. It is for those who would benefit by the institution of such an extended search to press upon the Government the importance of this method of stimulating invention and industry.

Technical Problems of the Painter's Art.

Papers of the Society of Mural Decorators and Painters in Tempera. Second volume, 1907–1924. Edited by John D. Batten. Pp. v+134+6 plates. (Brighton: Printed for the Society by the Dolphin Press, 1925.) 10*s.* 6*d.*

THE Society of Mural Decorators and Painters in Tempera is to be congratulated on having produced a volume of fascinating interest to those who are intrigued by the practical problems of the painter. The trouble is that it suggests so many queries, criticisms, and comments and opens up so many lines of inquiry that it requires a volume rather than a brief article for adequate treatment.

The painter of pictures and of wall decorations of to-day is in the unfortunate position of having lost invaluable studio traditions and having to rely on obscure and doubtful records of old methods of painting. The Tempera Society is, therefore, on the right lines in trying to bring together the experience of the painter, the information to be obtained from ancient records and the critical examination of old pictures, and in addition, the knowledge of the man of science. When all this has been done, the difficulty remains that there are many problems that can be solved only by the study of the slow but inevitable action of oxygen, of moisture, of light, and possible internal changes in the materials themselves through long periods of time.

All the publications in this volume are not new to those who are closely in touch with the subject, but they are none the worse for being reprinted, the papers by Mr. Neol Heaton on the frescoes at Knossos and by the late Sir George Beilby on lime putty being of special interest. Mr. Tudor Hart is also to be congratulated on his excellent recipes for preparing egg and size emulsions. He has had much experience in the use of these mediums. The systematic and scientific study of emulsions which is at present in progress in many laboratories must ultimately prove of the utmost value to the painter in the egg or tempera medium, and the modifications of it produced by the addition of drying oils and varnishes.

There are two urgent problems before the painter to-day. One is the problem of wall decoration under modern conditions of air laden with coal smoke and oxidation products of sulphur dioxide. It is admitted that painting with selected pigments mixed with water on wet lime has proved the most permanent method of wall decoration under suitable conditions, and it has an æsthetic value which is not obtainable by an oily medium no matter how much the oiliness of oil is suppressed by the addition of wax; but it

is obviously peculiarly liable to attack and injury under the atmospheric conditions existing in our modern cities, and it is at any rate open to question whether the northern tradition was not in favour of the use of oil, as shown by the early records of the purchase of painting materials both at Westminster and Ely. Mr. Tristram, who has been cleaning the tombs at Westminster, gives his verdict in favour of size either emulsified with or afterwards varnished with oil. I had the opportunity of examining some tiny samples from the Westminster tombs and can confirm the presence of oil, which shows that in the north there was no objection to an oil effect on decorated stone. I also found azurite, the native copper carbonate blue, and in that connexion a curious technique, namely, a layer of white lead in oil next the stone covered with a gesso containing vegetable fibre, suggesting that it was considered necessary to protect the azurite from any possibility of damp coming from the stone.

I am disposed to think we should boldly accept an oil technique for wall decorations under modern conditions. Where Buon Fresco can be used safely, it is supreme; and if we ultimately adopt scientific methods of heating, its revival should be possible even in the cities of this country. But even in this technique there are still unsolved problems. Pliny and Sir Arthur Church both agree in throwing doubt upon the use of certain yellow ochres in Buon Fresco. Mr. Burton suggests Perigord Ochre, but further inquiry and research are necessary.

The other problem facing the painter to-day is the correct use of the oil medium in the painting of pictures. Artists complain of premature cracking which occasionally occurs, and more generally of a lowering of tone from which some painters suffer much more than others. The Tempera Society in its return to the egg medium of the Italian painters of the thirteenth, fourteenth, and fifteenth centuries, represents a revolt from oil, which, owing to its facile easiness as a medium, leads to reckless use and consequent trouble.

The researches of Prof. Eibner, of Munich, have done much to put us on the right lines for solving the problem of cracking. The lowering of tone is due to the neglect of the study of the optical properties of the dry oil film of increasing age, and the reaction of these optical changes on the optical properties of the pigments. When we possess as complete a knowledge and mastery of the optical as well as of the chemical properties of the oil mediums as was possessed by Van Eyck and his followers, we shall find the solution to both these problems.

By a return to the combined tempera and oil technique, along with a thorough understanding of the optical properties of the oil film and its effect on pigments, and the obtaining in addition of a reliable backing for our pictures, better than canvas primed in the usual way, will be found, I hope, a way out of our difficulties.

In the meantime, all praise to the Tempera Society for its courageous attack on these problems. My only criticism is that they are not availing themselves sufficiently of the services of the chemist. The excellent work done, as revealed in this publication, by Burton, Noel Heaton, and Beilby, shows how much more we could do in the way of advice, criticism, and caution, and we are all anxious and willing to help.

The Society has already widened its remit so as to include wall decoration. Might not room also be found for the contemned oil medium?

A. P. LAURIE.

Geophysics in France.

Traité d'électricité atmosphérique et tellurique. Publié sous la direction de E. Mathias par J. Bosler, Dr. P. Loisel, Prof. R. Dongier, Prof. Ch. Maurain, G. Girousse, Prof. R. Mesny. (Comité Française de Géodésie et de Géophysique: Publications de la 6e Section.) Pp. xx+580. (Paris: Les Presses universitaires de France, 1924.) 40 francs.

THE U.G.G.I. (Union Geodétique et Géophysique Internationale) is a post-War body which meets normally once in three years, and has for its props and feeders national committees of geodesy and geophysics in the countries which give their financial support. The Union is subdivided into sections, of which one known as T.M. and E. deals with terrestrial magnetism and electricity. The French national committee, being a business like body, has corresponding sections, each apparently with its president and secretary. The section answering to T.M. and E. is known as No. 6. Its president is M. D. Berthelot, membre de l'Institut, and its secretary Prof. E. Mathias, director of Puy de Dôme Observatory. The president contributes an eloquent preface of seven pages to the volume. He explains that it represents a labour undertaken by the section at the suggestion of Prof. Mathias. The completion of so comprehensive a treatise would, as he says, require enormous labour and profound erudition on the part of any one man, and during the years required to write it fresh knowledge would accumulate. Common sense thus dictated co-operation, and in M. Berthelot's words, "Une pléiade de spécialistes distingués ont bien voulu nous prêter leur bienvaillant et désintéressé concours." The general arrangement and supervision fell to Prof. Mathias, whose devotion

to his self-imposed labours merits all respect. The production of such a work must have been costly. It is thus interesting to note that a subvention was received from the Caisse des Recherches Scientifiques, the president of which is M. A. Lacroix, permanent secretary of the Academy of Sciences. An enumeration of the several authors and their contributions will give, it is hoped, some idea of the wide compass of the volume.

Prof. R. Dongier treats of the earth's electric field, the instruments used in measuring it and the results obtained. In a short note later in the volume, he discusses the theory of the quadrant electrometer. Prof. C. Maurain, Director of the Geophysical Institute, Paris, writes on loss of charge, ionisation and conductivity of the atmosphere, and on atmospheric currents and conduction. Dr. P. Loisel discusses radio-activity of the air, with subsections on the radio-activity of the earth and of wells, and he treats of the relations of radio-active substances to the earth's internal heat. Prof. R. Mesny deals with radio-telegraphy and atmospherics. M. J. Bosler, Director of Marseilles Observatory, discusses earth currents (of natural origin). M. G. Girousse, Director of Triphasé (Nord-Lumière), deals with earth currents of artificial origin.

The longest contribution, by Prof. Mathias, Chap. I. of Part II., is a discussion of electric discharges in the atmosphere. Besides St. Elmo's fire, lightning of various kinds, and lightning conductors, he includes also aurora. Prof. Mathias also supplements the work of Prof. Maurain by a discussion of the mobility of ions in the atmosphere, and the various laboratory ways of measuring it. Further, he discusses rainfall electricity, and writes three supplements at the end of the volume. The first and last of these, devoted respectively to the so-called black flash and to Vegard's recent work on the spectrum of aurora, are very brief. The second gives an account of the writer's own recent speculations on thunder and lightning.

As to the other contents, there is a copious bibliography at the end of each section, and at the end of the book an authors' index. As evidence of its completeness, it may be mentioned that under the heading "Elster et Geitel" there are 39 references, and the same 39 references appear on the same page under the heading "Geitel et Elster." There is no subject index, but there is a very full table of contents.

A few words must suffice for comment on the several contributions. M. Dongier's account of instruments for measuring potential gradient is well illustrated. Chauveau is quoted as to the great superiority of photographic recorders as compared with the Benndorf electrograph. In this we concur, but we should associate the former type rather with the name of Kelvin than that of Mascart. Many important practical details are mentioned, including the reduction to the infinite plane. Diurnal variations are represented, perhaps somewhat superficially, by numerous diagrams.

The articles of Profs. Maurain and Mathias on ionisation and conduction show little overlapping, and form an excellent discussion of the subject.

Dr. Loisel commences with a general discussion of radio-active transformations and then passes to atmospheric phenomena, including the ionisation in closed vessels. In discussing Messrs Campbell and Wood's observations he accepts their assumption that the diurnal variation of potential gradient has the same character at Cambridge as at Kew. This wants confirmation. Dr. Loisel gives a large number of data for the radio activity of rocks and of mineral wells. The bibliography at the end of his article has 122 entries.

In his discussion of thunder and lightning, Prof. Mathias devotes considerable space to lightning conductors, and to a historical discussion of Franklin's discovery that lightning is an electrical phenomenon. The meteorological aspects, frequency and diurnal variation of thunder, are scarcely touched on. Aurora is not a prominent "meteor" in France, and the survey made of it is somewhat rapid. It refers, however, to Stormer's height measurements, and to the results of his mathematical calculations.

In his discussion of rainfall electricity, Prof. Mathias treats very fully of Dr. Simpson's observations at Simla, and inclines to the opinion of Nolan and Enright that "la théorie préconisée par Simpson est pleinement compétente pour expliquer les phénomènes électriques observés des orages à foudre" (p. 381). Another research to which he devotes special attention is the interesting recent work of Norinder on the electric field during thunderstorms.

M. Mesny, after discussing the apparatus and methods of radio-telegraphy, gives much valuable information about the variation in the facility of propagation of electric waves of various lengths, about variations of azimuth, and about atmospherics. In the latter topic he has many references to the work of Mr. Watson Watt.

M. Bosler narrates the historical development of our knowledge of earth currents, and describes the means of recording them employed at the observatories of Parc St. Maur and the Ebro. He discusses the diurnal variations observed at these two stations and Weinstein's results for Germany. Contrasting the records of earth currents and magnetic variations at Parc St. Maur, he infers apparently that the latter are largely

a consequence of the former, so far at least as irregular changes are concerned.

M. Girousse's discussion of artificial earth currents requires some knowledge of electrical engineering for its full comprehension, but the general conclusions are easily followed. What specially interests M. Girousse is apparently the financially important question of the electrolysis of underground pipes.

Taking the volume as a whole, British workers have no reason to complain of lack of recognition—except perhaps in the case of the thunderstorm work of Prof. C. T. R. Wilson—and their names are usually tackled successfully. Lennan, however, without the "Mac.," p. 286, has a somewhat Bolshevist appearance. In view of the present cost of printing, a similarly comprehensive work in English seems a remote contingency for years to come. Physicists of the older generation owed much to the works of Deschanel and Ganot, and present-day geophysicists who read French easily will find the treatise under notice of great assistance in their studies. C. CHREE.

Modern Entomology.

(1) *Anatomy and Physiology of the Honeybee.* By R. E. Snodgrass. (McGraw-Hill Agricultural and Biological Publications.) Pp. xv+327. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1925.) 17*s.* 6*d.* net.

(2) *A General Text-book of Entomology: including the Anatomy, Physiology, Development and Classification of Insects.* By Dr. A. D. Imms. Pp. xii+698. (London: Methuen and Co., Ltd., 1925.) 36*s.* net.

IN 1910 the United States Bureau of Entomology issued a Bulletin by Mr. Snodgrass on "The Anatomy of the Honeybee," which immediately attracted attention, and has since maintained its place as the authoritative work on the subject. The present volume, as its title implies, has a wider scope, and contains a greater proportion of matter derived from the researches of others. The additions are judiciously selected and well presented. Nothing is final, but the book may stand as a fairly complete statement of our present knowledge of the morphology and physiology of this important insect, and the hope of the author that our ideas of the bee may hereby be placed "on a surer scientific basis than before" is amply justified.

An interesting section deals with the senses of the bee. There is no evidence that bees hear, but the senses of sight and smell are fully discussed, results published by investigators so recently as 1924 being duly incorporated. As regards smell, perhaps too much space is accorded to the rather crude experiments of M'Indoo, which led him to deny to the antennæ any great importance as olfactory organs. Justice is done, however, to the more convincing work of von Frisch, who was careful to use non-irritant odours under some approach to natural conditions, and who not only reinstates the antennæ, but also considers that the pore-plates of the last eight segments are the special organs of smell.

The illustrations are for the most part admirable. Many are, of course, retained from the original Bulletin, and some of these have become very familiar from their recurrence in all manner of zoological text-books. But there are many new figures of an equally high standard of excellence. One of the least satisfactory bears the legend, "Isle of Wight disease mites," but there is no reference to these parasites in the text. Mr. Snodgrass is not of course concerned with pathology, but if he finds room for Dr. Rennie's Acarapis, it might be useful to indicate the particular tracheæ to which it is always confined.

In typography and clearness of arrangement the book is all that it should be, and Mr. Snodgrass has a lucid and pleasing style without a trace of transatlantic idiom, so that we need not complain if he conforms to his country's idiosyncrasy in the spelling of certain words.

(2) Dr. Imms has broken new ground in his "General Text-book of Entomology." The multitude of insect books published in English during the last fifty years have for the most part fallen into one of two categories. There is the Nature-study variety, chatty and discursive, and drawing largely from the incomparable J. H. Fabre, and there is the collector's hand-book variety, concerning itself entirely with the adult insect, and designed to aid the young collector in the identification of his pinned specimens. Few have dared to deal with the vast subject of entomology as a whole, and if this was a staggering task fifty years ago, what is it now, in view of the tremendous annual output of more or less original material? Thirty years ago Dr. David Sharp remarked that insects were the most numerous in species and individuals of all land animals, and estimated the number of known species at about 250,000. According to Dr. Imms, 450,000 species have now been described.

Just about a century has elapsed since W. Kirby and W. Spence completed in four volumes—the first edition of a work which was destined to enjoy a great vogue for many years. The seventh edition appeared in 1856 as a single volume. This work, written in the epistolatory style, was distinctly of the Nature-study order, and was deservedly popular for its store of information concerning the habits of all manner of insects.

In 1885 W. F. Kirby published an "Elementary Text-book of Entomology" dealing with the subject from an entirely different point of view, and doing what was possible, in the space of 240 pages, and with the aid of some excellent plates, to enable the budding entomologist to find his way among the orders and families of insects at that time recognised. The second edition appeared in 1892. Then, at the close of the century, came two remarkable works. The first portion of Dr. David Sharp's treatise on insects in the "Cambridge Natural History" appeared in 1895, and the concluding part in 1899. Meanwhile, in 1898, Dr. A. S. Packard published in America his "Text-book of Entomology."

Dr. Packard's work was entirely morphological, and appealed and still appeals to the advanced student of comparative anatomy. Dr. Sharp's treatise was, we believe, the first serious attempt to deal with the subject from all aspects, and, so far as was possible in the space at his disposal, he succeeded triumphantly. It is surprising how often workers in the most varied fields find in his volumes precisely the kind of information they require.

But Dr. Sharp cared not at all for applied entomology. The threatened extermination of a rare insect excited his indignation, but the too great abundance of a common species left him cold. His sympathy was distinctly on the side of the insects.

Now, during the present century, the number of workers in the economic field has vastly increased. It is even true to say that a large proportion of our recent advance in entomological knowledge is directly due to them. What did we know of mosquitoes or of fleas before their proved connexion with malaria and bubonic plague Consider the condition of our acquaintance with Hymenopterous parasites before their importance in the control of crop pests was recognised. Dr. Imms dedicates his book to teachers, advanced students, and those engaged in research, and we feel sure that in the last category he had specially in mind that body of economic entomologists of which he is himself a distinguished member. If we add the fact that in a subject attracting so many workers, books a quarter of a century old are necessarily in many respects out-of-date, we see that a new venture was urgently called for, could any one be found sufficiently equipped and sufficiently daring to undertake it.

By what criteria must Dr. Imms' work be judged? Originality, except in the general scheme of presentation, would be a positive blemish. The essential points are that the selection of matter, necessarily very rigorous, should be well balanced and clearly presented; that the latest—not always the latest propounded, but the latest approved—conclusions should be incorporated, and that the student should be put on the track of further information on the point which especially interests him.

On the whole, the book before us stands these tests extremely well. The bibliographies at the end of each section are most valuable, and the chances are that a "research worker," to use Dr. Imms' term, consulting the work on any particular point, will find a concise and trustworthy statement of what is known, and an indication of the sources whence more detailed information may be obtained.

We note that Dr. Imms does not cater for the medical entomologist, who, he doubtless considers, is well provided with his own special entomological text-books. We may instance the short chapter on fleas, which includes no figures of internal structure, and presents a scheme of classification not too recent and referring only to British species.

We congratulate Dr. Imms on the production of a book which will be valuable to a large number of students and indispensable to not a few.

C. W.

Industrial Research in Cotton.

Shirley Institute Memoirs. Vo 1924. Pp. vi + 362 + iv. (Manchester: British Cotton Industry Research Association, 1924.) n.p.

THE volume under notice includes twenty-seven original papers in cotton research and an excellent summary of the literature on the action of light on dyes applied to cotton fabrics.

Our knowledge of the botany of the cotton plant is already very extensive, and it is of more than passing interest to find in these pages a further advance in the study of the cytology of a plant so long cultivated. A count of the chromosome numbers in many varieties of Old and New World cottons has shown that the numbers fall into two groups of 26 and 13 chromosomes, the former comprising the cottons of the New World and Egypt, and the latter those of Asia. Unsuccessful attempts to cross American or Egyptian with Indian cottons have often been made, and a possible explanation of the difficulty is thus established.

The effects on cotton of the mechanical action of several processes through which it passes in the spinning mill have been thoroughly investigated, and although tendencies in modern industrial practice are in the main justified, the precise information obtained is invaluable. The necessity for the control of the atmospheric conditions in testing and in many technical processes is strikingly demonstrated by investigations on the influence of humidity and temperature on the elastic properties of cotton hairs and the absorption of moisture

by raw and soda-boiled cottons. Recent botanical views on the micellar structure of cotton have been strengthened by further and more trustworthy information on moisture hysteresis in cotton, which extends to 1·8 per cent. and not to zero relative humidity as was formerly found. Using the Anderson capillary formula, the calculated diameter of the smallest pores (or the smallest distance between the micelles) is of the order of 13×10^{-8} cm.

Micro-analytical methods for the examination of small quantities of waxes are described and the main constituents of the waxes extracted from some American and Egyptian cottons are very similar. The phosphorus and nitrogen contents are consistently greater in Egyptian than American cottons, and in spite of environmental variations the phosphorus content can be used to distinguish between them. It is not possible to say how these results can be utilised in the improvement of the physical properties of cottons, but there are hopeful indications that their application may provide the grower with a means for controlling the quality of the crop. The cotton breeder is badly in need of information in a utilisable form on manufacturing quality, and those who dream of a cotton industry including the grower as well as the spinner may yet see their dreams realised.

A study of the swelling of cotton cellulose in potassium hydroxide solutions, following an investigation into the action of solutions of sodium hydroxide (the reagent used commercially in mercerising), has produced interesting results of a purely scientific nature. The increase in diameter of the cotton hair is less than half that attained in sodium hydroxide solutions, and maximum swelling obtains in the solution of maximum electrical conductivity. It is tentatively suggested that the action of the metallic ion on the swelling of cotton cellulose is consistent with the ionic theory of the swelling of colloids.

On glancing through these twenty-eight researches, one is struck by the number of positive results obtained. The keen practical man should welcome this precise information even though its immediate commercial application may be subject to modification by industrial limitations. Those only interested in the commercial usefulness of the knowledge, who have experienced difficulty in reading the earlier volumes in this series, will have no cause for complaint on this ground. Each paper in this volume is preceded by a short abstract in which the possible industrial applications of the results are written in terms which should be easily understood. Those who have not access to these memoirs, which are not purchasable, will find all these researches published in the Journal of the Textile Institute. F. P. S.

French Science and Philosophy.

Histoire de la nation française. Par Gabriel Hanotaux. Tome 15 : *Histoire des sciences en France.* Deuxième volume : *Histoire des sciences biologiques*, par Prof. Maurice Caullery ; *Histoire de la philosophie*, par René Lote. Pp. 619+12 planches. (Paris : Plon-Nourrit et Cie, 1924.) 50 francs.

Histoire de la nation française. Par Gabriel Hanotaux. Tome 14 : *Histoire des sciences en France.* Premier volume : *Introduction générale*, par Émile Picard ; *Mathématiques, mécanique, astronomie, physique et chimie*, par Henri Andoyer, Prof. Pierre Humbert, Prof. Charles Fabry, Prof. Albert Colson. Pp. xx + 619 + 12 planches. (Paris : Plon-Nourrit et Cie, 1924.) 50 francs.

THE fifteenth volume of M. Hanotaux' "Histoire de la nation française" is devoted partly to a history of the biological sciences by M. Maurice Caullery, partly to the history of philosophy by M. René Lote. It is a great book in both senses of the term. Each author is extremely well qualified for his task and each has taken great pains in its performance. The proportion of space allotted to science speaks well for the understanding of the general editor, for there is another volume on physical and mathematical sciences, and M. Caullery is careful to lay down at once the right principle for dealing with science or philosophy in such a national work as this. "One cannot write a 'national history' of any science. The history of all the sciences is essentially international. . . . What can be done, and has been attempted here, is to take a particular country as a centre of observation and trace the connexions of the scientific movement there with the general march of thought."

France has a distinguished place in both parts of this volume. Cuvier, Lamarck, Claude Bernard, and Pasteur are a series which will bear comparison with the biologists of any other nationality, and in general philosophy the quality of French thought is well brought out by M. Lote when he speaks of the equilibrium of the French spirit "raisonnable sans froideur, imaginatif sans fantasmagorie."

The work has been very well done, especially the letterpress, which would command a still larger sale if produced in two small volumes. The illustrations, which are abundant, will arouse more mixed feelings. They are mostly drawings not executed with the highest French finish—of portraits, tombs, houses, connected with names in the text. The present reviewer finds the black and white drawings not unsatisfactory, but would be happier without the coloured plates.

The fourteenth volume, containing the history of mathematics, physics, and chemistry, came to hand

after the above was written, but it fully bears out the judgment we have expressed and is in some ways better than the fifteenth. M. Émile Picard writes a general introduction describing the characteristics of the French contribution to science and advocating some teaching of the history of science as part of the lycée course. On both subjects he is enlightening and impressive. The general quality of French scientific and philosophic thinking is admirably illustrated by the section on the history of mathematics by MM. Andoyer and Humbert. Vieta, Descartes, Fermat, Bernoulli's, Lagrange, Laplace, Cauchy; it is a magnificent series with which no other nation can compete. If science consists in "mathematising" knowledge, the French have done most in the modern world to advance it, and it is they and not the Germans who come nearest to the rôle of the Greeks. But these French volumes are conceived and executed in as great a spirit of impartiality as is consistent with the general idea of a national history; no great name is omitted, whether it be British, Italian, or even German, though the portraits and other illustrations are almost entirely French.

It is an eloquent testimony to the intellectual elevation of our neighbours that so large a share of a general history of the country should be given to science and philosophy and that the work should be done so well. There is certainly no parallel in any English history, and the two volumes together form perhaps the best extant sketch of the history of science, complemented by M. Lote's section which treats philosophy from the scientific view-point. This also is a feature more common among the French than with us. We heartily congratulate both them and M. Hanotaux on a valuable contribution to scientific synthesis. F. S. M.

Electrodynamics and Radiation.

Scientific Papers, mainly on Electrodynamics and Natural Radiation: including the Substance of an Adams Prize Essay in the University of Cambridge. By the late Prof. Samuel Bruce McLaren. Pp. vii+112. (Cambridge: At the University Press, 1925.) 8*s.* 6*d.* net.

THIS small volume of the papers written by the late Prof. McLaren before he met an untimely fate in the War, and now collected together by some of his friends, will undoubtedly be received with somewhat mixed feelings. The pleasure that we experience in reading and re-reading his delightful analyses of questions which have been the subject of such ardent discussions and are still far from settled, can scarcely be separated from the thoughts of the great loss which science suffered by his death.

The papers themselves are preceded by a short biography of Prof. McLaren, written by Prof. Hugh Walker, which gives an insight into the very human side of McLaren's personality. Then follow the papers on radiation and gravitation drawn up by Dr. J. W. Nicholson. Here we find the classical argument, developed, however, with exceptional analytical power and considerable elegance, against equi-partition and Newtonian mechanics, the conclusion being, as usual, that if we regard the normal oscillatory co-ordinates as being all statistically equivalent, then Newtonian mechanics involves equi-partition. It would, of course, be surprising if the result were otherwise, but the fault is not necessarily with the mechanics; the independent probability argument is capable of bearing at least some of it.

In the later parts of these papers McLaren branches off into highly speculative proposals. Taking the ether—with the electromagnetic equations to define its activity—and assuming that matter in its smallest element (electron) is merely a small spherical sink in the ether, much as a perfect conductor would in fact be, he develops a formal electromagnetic scheme which includes the usual hydrodynamical attractions between sinks as a possible gravitational force. Any such theory is, of course, open to the usual objection that it either assumes too much or results in too much, but it is here developed by McLaren with an attractiveness which compels attention.

In the second set of papers, edited by Prof. Hassé, these ideas are pushed further to include a theory of magnetism. Here the magneton is introduced as a ring sink in the ether—a perfect conducting circuit with a current in it—and calculations of the associated energy and momentum are made and compared with fundamental data. The revolving electron theory of the magneton is rejected as being incapable of explaining paramagnetism on the lines developed by Langevin, the idea being that since the mechanical force exerted on an electron by a magnetic field is at right angles to the direction of motion of the electron, it can never do the work which is required for the orientation of the orbit. There appears to be a slight confusion of thought in this criticism. When a circuit carrying a current moves in a magnetic field, the magnetic forces acting on the contained electrons have a double effect. The components at each point perpendicular to the main direction of the current flow balance the mechanical reaction forces acting on the element there, and the other components balance the electrical or other forces driving or retarding the current. The energies associated with these two actions are, in the usual circumstances, equal in amount but opposite in sign, so that the total is zero, and the only

effective result of the action of the magnetic field is a redistribution of the energy as between the mechanical and internal types.

In the last paper, not previously published, and now edited by Prof. Havelock, McLaren discusses the propagation of a disturbance in a dispersive medium by the Fourier method. Here he proves that the mathematical difficulties, which at first appear to be inherently involved in the method, do not, in fact present themselves, and that results are obtained which are fully consistent, so far as it is possible to follow them, with the physical ideas of propagation by waves and wave groups.

This short review will perhaps give some idea of the scope of McLaren's work, which was all accomplished in the short space of three or four years. The book into which it is now all collected will serve as a worthy memorial—it is produced by the Cambridge Press in their usual excellent style—to a fallen colleague, and it can be recommended to every one interested in the subjects with which it deals. They will find in it an interesting and still to great extent novel discussion of matters in which alternative points of view are still more than welcome. G. H. L.

Our Bookshelf.

Pygmies and Bushmen of the Kalahari: an Account of the Hunting Tribes inhabiting the great arid Plateau of the Kalahari Desert, their precarious Manner of Living, their Habits, Customs and Beliefs, with some reference to Bushmen Art, both early and of recent date, and to the neighbouring African Tribes. By S. S. Dornan. Pp. 318 + 16 plates. (London: Seeley, Service and Co., Ltd., 1925.) 21*s.* net.

THE lower the savages, the more difficult it is to make observations among them—to endure the adverse climate or conditions of their habitat, to follow their shifting, unsettled mode of life, to overcome their diffidence. Our literature about the pygmy race and the so-called primitive food-gatherers is as scarce as it is important for anthropology. The recent additions by trained scientific field-workers—the books of Prof. and Mrs. Seligman on the Veddahs, of Dr. Radcliffe-Brown on the Andamanese, of the Rev. W. Koppers on the Firelanders—have aroused great interest and already influenced anthropological argument. About the Bushmen we know, in spite of some good older accounts, only too little, and the present volume is welcome, written as it is carefully, in a clear attractive style, and by one who can claim that "for the opinions expressed in the book the author alone is responsible." It represents mainly the writer's own experiences with the Bushmen and Bechuanas.

The bulk of the volume and its most valuable part consists of Chaps. v.-xxii., on the Bushmen of the Kalahari. The descriptive pages are good, especially when they refer to tangible objects—clothing, household goods, implements, weapons and such like; or the typical pursuits—the chase, warfare, trekking and fishing, which, surprising as it sounds, exists in the arid desert of the Kalahari. The sociology of these nomadic savages is given but in a cursory manner, as is natural from an amateur ethnographer. Even in a chapter with the promising title, "Organisation of Family and Clan," there are, for six descriptive pages on physical appearance, only one page and a half on sociology—and this very slightly treated. Some interesting information about the tests in hunting skill and endurance necessary for marriage are given in Chap. xiii. ("Family life—Marriage, Children, etc."), but the remarks about sexual relations, family life and kinship ties do not go beyond generalities and will be of little use for the comparative sociologist.

The most interesting passages of the book are detailed statements of personal experiences of the writer, as they throw some light on the mentality of the natives and on their conduct in ordinary life. What Mr. Dornan has to say about "Food and Feeding" (Chap. xii.), about personal relations, about their beliefs and folklore (Chaps. xv.-xix.) is often quite good. The chapter on "Knowledge of the Veld and its Lore" shows us the native as a good observer, capable of empirical conclusions and logical argument. It should be helpful in dispelling the myth of "savage prelogical mentality."

B. M.

In Southern Seas: Wanderings of a Naturalist. By Dr. W. Ramsay Smith. Pp. xviii + 297 + 16 plates. (London: John Murray, 1924.) 16*s.* net.

IN this attractive little book a naturalist at ease and in his holiday mood gives us his impressions and personal opinions on several subjects, which he has treated at other times professionally and of which he takes now a bird's-eye view during a recreation trip through New Caledonia, the New Hebrides and Northern Australia. The flippancy of style, which seems to be considered a matter of duty in such books, does not interfere substantially with the serious purpose of the book, directed mainly to the study of native races. The traveller in the South Seas is naturally led to melancholy musings about the appalling extent of depopulation, the decay of native culture and custom and he is made to reflect upon the cause of it all. "The total effect of all well intentioned or ill-meaning interference with long-established customs and observances, which were evolved with the race itself and were necessary for its existence and well-being, has too often been to break up the social fabric and destroy physical vigour; it has meant degeneracy or death or both." Dr. Ramsay Smith asks the question which must have occurred time and again to every anthropological field-worker and to any thinking and sympathetic white man in contact with natives: "Why should it be considered essential to interfere with such customs?" Above all, it might be added, why should we try to destroy all which the natives hold sacred and important, their beliefs, rites, morals, and that while our own religion, which we try to force on them, becomes but its own travesty once it has been grafted upon stone-age mentality. "There is no guarantee that the oil or even the Lord's anointed will not turn rancid in some of these places," says the author, and indeed some reflection might have warned us that they are bound to; experience teaches always the same lesson—that they turn

rancid and poisonous, and that in spite of the best intentions.

The five chapters on Australian aborigines are instructive, especially where the writer deals with problems of race and physical anthropology. It is a pity that no references to other authorities are given, while the information is obviously not all based on personal field-work. About the Melanesians there are certain extraordinary statements, such as that "the savage lord of creation does little or no work except to make his wife or wives work" (p. 52). Those of us who know the Melanesian at first hand will feel astonished how any one who has visited the islands even on a flying trip could have carried away such an impression.

B. M.

Nauka Polska: jej Potrzeby, Organizacja i Rozwój. Tom 5. Pp. vi + 553. (Warszawa: Inst. Mianowskiego, 1925.)

La science polonaise: ses besoins, son organisation et ses progrès. Résumé français des articles parus dans le volume 5. Pp. 36. (Varsovie: J. Mianowski, 1925.)

FROM the French résumé of the articles in the larger work in Polish we can learn in outline the needs, organisation, and progress of science in Poland. This is the fifth annual volume which has been issued by the Caisse J. Mianowski, an institute for the encouragement of scientific work. Earlier volumes have dealt with the more urgent scientific needs of Poland, proposals for the allocation of funds, and a report of a congress on scientific organisation. Some of the more pressing problems concern agriculture, health, education, sociology, and geological survey. There are six universities—Warsaw, Cracow, Leopol, Lublin, Wilno, and Poznan, and local scientific societies at Plock, Thorn, Przemysl, and Sandomiez. Conferences have been held on physiography, on museums, on education. There are some foundations, the Academies at Wilno and Zamosc and the astronomical observatories at Vilno, Poznan, Cracow, and Warsaw, and a monument to Copernicus at Warsaw. Information has been collected as to the organisation of science in other countries—in France, Italy, Denmark, Czechoslovakia, and Finland. M. J. Wojciechowski contributes an article on "The co-operation of the state and of industry in scientific researches in England," with references to the articles by J. W. Williamson and Dr. Kenneth Lee in NATURE for November 15 and December 6, 1924. There is an evident willingness to co-operate with work abroad. Relations have been cultivated with France, Italy, Belgium, England, the United States, Switzerland, and Czecho-Slovakia; Poland has been represented at some forty international conferences. Polish savants—about two hundred—have been encouraged to travel. Scholarships are offered to foreign students. Contact has been made with the League of Nations Committee on Intellectual Co-operation.

It appears that, although with restricted finance, an endeavour is being made to prepare the conditions for a scientific advance. For this reason it may be increasingly important to watch the future volumes of this annual. The French abstract is already a useful interpreter. Perhaps in the future English and German abstracts could also be offered.

H. R.

The Mineralogy of Scotland. By the late Dr. M. Forster Heddle. Edited by J. G. Goodchild. Reprinted under authority of Alex. Thoms by the Council of University College, Dundee, assisted by D. E. I. Innes. Vol. 1. Pp. lviii + 148 + 51 plates + 4 maps. Vol. 2. Pp. viii + 250 + plates 52-103 + 7 maps. (Dundee: Frank Russell, 1923–1924.) 15*s.*

BY the publication of these two handsome volumes at so moderate a price, Mr. Alexander Thoms and the Council of University College, Dundee, deserve the thanks of all interested in the mineralogy of Scotland. Heddle's well-known work has, since its appearance in 1901, been an indispensable book of reference for mineralogists and petrographers, and it is satisfactory that so valuable a compilation has not been allowed to suffer the common fate of a mineral index and go permanently out of print.

It is unfortunate, however, that the opportunity has not been taken of removing some of the defects for which the original edition was criticised. The book possesses no adequate index, the first requisite in a work of this character, and in consequence the labour of tracing the descriptions of the minerals and their occurrences throughout the text is as long and irritating as it should have been unnecessary. The complete disregard of recent published work is also to be regretted. Thus, the interesting contributions made to the mineralogy of Scotland by the officers of H.M. Geological Survey working in Mull are not mentioned, and, as a result, the accounts of the mineral occurrences in that island are incomplete and sometimes erroneous.

Despite these blemishes, the book remains a lasting memorial of the enthusiasm and ability of the late Prof. Heddle. It is well printed and produced, and the illustrations are of excellent quality; but it is necessary to warn the reader that not a few of the drawings are examples of artistic crystallographic draughtsmanship rather than actual representations of the crystallography of Scottish minerals.

Substation Operation. By Prof. Edwin Kurtz. Pp. xiii + 261. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1924.) 12*s.* 6*d.* net.

THIS book is intended to help the workman to understand the principles of substation operation. It is a good attempt at giving somewhat advanced technical knowledge in such a way that it can be readily assimilated. Very little theory is given, and much of the information has been compiled from official American sources. We were interested to read of the care that is taken to protect the operator from shock and burns. Not only has he to wear rubber gloves, but he has to wear leather gauntlets over them. He has also to blow in the gloves to see whether there are any holes in them. In addition he has to put on a leather coat, which must be kept scrupulously clean, and when working with high tension switches he must stand on a stool thoroughly insulated from earth and so constructed that it cannot possibly tip over.

Full instructions are given to revive a man when he has had a shock. The patient is then to be given some stimulant, "such as one teaspoonful of aromatic spirits of ammonia in a small glass of water, or a drink of

hot ginger, tea or coffee." We are told not to use water to put out a fire at a substation before the station has been made completely "dead." The reason given for this is that the operator would receive a shock if he directed a jet of water on to a "live part." This may be true for very high voltages, but it is not true at low voltages. This book will interest station engineers in Great Britain.

Physiologische Pflanzenanatomie. Von Prof. Dr. G. Haberlandt. Sechste, neubearbeitete Auflage. Pp. xvii+671. (Leipzig: Wilhelm Engelmann, 1924.) 22 gold marks.

THIS work, originally published in 1884, is best known to English students from Prof. Drummond's translation of the fourth German edition. A fifth edition appeared, during the War, in 1917. The latest edition has been brought more up-to-date, especially by additions to the "notes" at the end of each chapter, the most useful feature being the references to recent German research. Some of the rather dogmatic statements of earlier editions have been modified, and it is acknowledged that modern cytological work has reopened questions, such as those relating to the origin of the chloroplastids and other chromatophores, which have previously been regarded as answered. By deletion of some less important passages the size of the book has been very little increased, though room has been found for brief accounts of such new discoveries as those of Merl and Czaja on the mechanism of the Utricularia bladders. Possibly owing to the lack of access to recent literature, English and American work appears to have been almost entirely ignored. Thus the account of mycorrhiza is very incomplete. Prof. Haberlandt realises that the subject will soon require a more basic revision than can be given without re-writing the whole book, but declares it is not possible for him to undertake this.

Fuel: Solid, Liquid and Gaseous. By Prof. J. S. S. Brame. Third edition. Pp. xv+388. (London: E. Arnold and Co., 1924.) 18*s.* net.

PROF. BRAME points out that the second edition of his book was published in 1917, when no large amount of revision was possible; since the issue of the first edition there has been very considerable extension of our knowledge of fuels for internal combustion engines, of the use of powdered coal as fuel, of the ignition points of fuels of all classes, on the velocity of combustion of gaseous mixtures, and on problems of low temperature carbonisation. All these subjects have been revised, and the chapters on liquid fuels for internal combustion engines have been re-written. Additional material on the composition and the coking properties of coal has also been included. The author has made full use of the publications of the Fuel Research Board, and has evidently found them of great value.

Metallurgy: an Elementary Text-Book. By E. L. Rhead. New and revised edition. Pp. xii+403. (London: Longmans, Green and Co., 1924.) 7*s.* 6*d.*

MR. RHEAD'S little book on metallurgy was first published thirty years ago, and has been through many editions. The copy before us is a new and revised edition published late last year. Considerable additions have been made throughout the book, especially in the metallurgy of iron and steel, copper, silver, gold, and nickel. Certain processes which have become obsolete or the importance of which has diminished have either been deleted or condensed into smaller compass. The author, however, has wisely retained certain other processes which, although obsolete or much modified, make clear the principles underlying their modern successors. Elementary metallography has been introduced, and we think he has done wisely in taking this step. There is no better method of emphasising that all metals and alloys at whatever stage of their manufacture, provided they are solid, have a definite structure. H. C. H. C.

The Marketing of Metals and Minerals. A Series of Articles by Specialists. Edited by Josiah Edward Spurr and Felix Edgar Wormser. Pp. xii+674. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1925.) 30*s.* net.

THIS work consists of a series of articles, each written by a specialist, describing the methods of commercial dealing in the metals, ores and non-metallic minerals produced by the labours of the metallurgist and the miner. The economic side of the great mineral industries has been generally neglected in literature, and the present work will be welcomed by a large circle of readers. Unfortunately for us, it refers almost exclusively to American conditions, and whilst therefore of very great value to any one connected with the mineral industry in the United States, its usefulness in Great Britain will be limited to the relatively few people who deal with the United States in mineral products. A companion volume dealing with British conditions and methods would be of very great value, especially at the present moment.

Laboratory Manual of Organic Chemistry. By Dr. Harry L. Fisher. Second edition. Pp. xii+338. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1924.) 11*s.* 6*d.* net.

DR. FISHER has introduced some improvements and additional experiments into the second edition of his excellent book. The principal feature is the thoroughly practical character of the information, and the innumerable hints and details given in the descriptions of preparations and experiments will be found of the greatest value to students and demonstrators. References to important new work are frequently given. The section on elementary analysis is very detailed, and is perhaps the best account in existence.

A Class-Book of Chemistry. By G. C. Donington. Part 5: *Organic Chemistry.* By Prof. T. M. Lowry and Dr. P. C. Austin. Pp. vi+531-706. (London: Macmillan and Co., Ltd., 1925.) 5*s.*

THIS volume is a continuation of Donington's well-known class-book, and a further volume on physical chemistry is promised. The treatment is clear and accurate, and several good experiments are included. The book is suitable for medical and pharmaceutical students, and provides generally a useful introduction to organic chemistry. Recent work (*e.g.* on the structure of sugars and starch) is included.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Fluorescence of Cadmium Vapour.

IN the course of the study of band spectra of cadmium and zinc, the question arose whether the vapours of these metals show a fluorescence analogous to the well-known green fluorescence of mercury vapour. To decide this problem, the following experiment was made.

A quartz bulb was thoroughly evacuated, adsorbed gases being removed by heating it to a high temperature for some days. Then a few milligrams of pure cadmium were distilled into the bulb, which was finally sealed off from the pumps. The bulb being put into a nichrome-wire furnace, a beam of exciting light from a condensed spark, an arc, or a mercury lamp was projected through the bulb by the aid of a quartz lens.

It was found that the fluorescence of cadmium vapour, in the form of a blue-coloured beam of light, strictly limited to the path of the exciting beam, makes its appearance and continues over a considerable range of temperature and density of vapour. By increasing gradually the temperature of the furnace, first traces of the fluorescence appear about 450° C.; with further increase of temperature the intensity of the fluorescence is augmented, and from 600° to about 750° it is very pronounced. At a still higher temperature the direct observation of the fluorescence is impeded by the bright glow of the furnace. Using a blue glass screen to cut out the red glow of the furnace, however, the fluorescence can be observed up to a temperature of about 950° and more, its intensity being considerably diminished.

In order to determine the exciting wave-lengths, various sources of light were employed: a condensed spark with the electrodes of cadmium, zinc, aluminium, magnesium, copper, lead, tin, carbon and iron; iron, cadmium and carbon arcs, and also a mercury lamp. Almost all these sources gave a more or less intense fluorescence. Especially strong fluorescence is produced by the cadmium spark; a very faint one by the magnesium spark; the carbon arc does not produce any fluorescence at all.

The excitation of the fluorescence being produced by such different sources of radiation proves the spectral extent of its excitation to be rather broad. It lies at any rate below 3000 Å.U., as not only a thin sheet of glass, but of uviol as well, put in the path of the exciting beam extinguishes the fluorescence completely.

An addition of small quantities of other gases seems also to have a destroying influence upon the fluorescence, as proved by the following experiment: The bulb, showing a very intense fluorescence, was heated by the Bunsen flame for fourteen hours. It was found then that its fluorescent property disappeared totally. This is probably due to the diffusion of hydrogen from the flame through the red-hot quartz into the bulb. To demonstrate the presence of hydrogen in the bulb, the latter was excited at room temperature by the electrodeless discharge of a Tesla transformer. In the spectrum were found some hydrogen lines, which were absent before the heating.

In order to examine separately the influence of temperature and density upon the fluorescence, a quartz cylinder provided with a side-tube and having two plane-parallel windows was used. The cylinder and the tube could be heated independently in two separate furnaces. First of all it was noted that during the rapid evaporation of metal drops condensed on one of the windows, the fluorescence appears particularly intense. However, the existence of fluorescence in the bulb, where a permanent distillation does not take place, proves that the evaporation is not an indispensable factor in the appearance of fluorescence.

The study of the spectrum of the fluorescence is rather difficult owing to the long exposures (several hours even when a spectrograph of small dispersion was used) which are necessary on account of a comparatively small intensity of light. It is also difficult to remove the exciting light scattered by the walls of the bulb.

The photographs of the spectrum and the curves got from these by a self-registering microphotometer show, however, that the spectrum has the appearance of a broad continuous band extending approximately from 5000 to 3950 Å.U. The decrease of intensity, especially towards the more refrangible end of the spectrum, is very gradual. The maximum of intensity falls about 4630 Å.U. This type of spectrum is analogous to the fluorescence spectrum of mercury vapour.

Further detailed investigations of the phenomena described are in development.

W. KAPUSCINSKI.

Warsaw,
Physical Institute of University,
June 1925.

The Band Spectra associated with Carbon.

THERE are now so many as thirteen band groups associated with carbon and its compounds. Some of these, such as the violet CN group, have been studied exhaustively, both empirically and upon the basis of the quantum theory. I have endeavoured to arrange in progressions and to assign vibrational quantum numbers to all of these groups, where such work has not yet been done, and several interesting new relations have resulted.

Lemon (Proc. Nat. Acad. Sci., 11, 41, 1925) has found that the first negative group and the comet-tail bands (low pressure CO bands) appear and disappear under the same experimental conditions, and Blackburn (*ibid.*, 11, 28, 1925) has made a quantum analysis of the former group. Simultaneously, Baldet (*Comptes rendus*, 180, 271, 1925) published measurements of the four heads of each of the 30 bands of the comet-tail group. Using the data for all four heads, I find that the first head is given by the equation

$$\nu = 20485{\cdot}4 + (1550{\cdot}46n' - 14{\cdot}07n'^2 + 0{\cdot}043n'^3) - (2198{\cdot}6n'' - 15{\cdot}00n''^2).$$

The remaining three heads are then given by substituting for the constant term 20471·6, 20359·1, and 20346·1 respectively. Using the older data quoted by Jevons (*Phil. Mag.*, 47, 586, 1924) as well as Blackburn's data, I obtain similarly for the heads of the first negative group

$$\nu = 45655{\cdot}4 + (1704{\cdot}42n' - 29{\cdot}3n'^2 + 0{\cdot}7n'^3) - (2197{\cdot}03n'' - 15{\cdot}17n''^2).$$

The assignment of the final vibrational numbers (n'') is very certain in the case of each of these groups, and it is evident that well within limits of error both groups correspond to the same final state, and are therefore due to the same molecule. The experimental evidence indicates that the comet-tail bands are due to CO, while, as the name indicates, the first

negative group is probably due to an ionised molecule. Hence it is probable that both groups are due to ionised CO.

The assignment of values of n' for the comet-tail bands is slightly uncertain, that adopted neglecting the λ5281 band given only by Baldet. This band is very weak and 3 A out of position. If included, it must be the 0,0 band of the group, an unlikely but not impossible state of affairs. The intensity distribution is such as to favour the initial states ($n' = 0$ to 11, while $n'' = 0$ to 3 only), quite an unusual distribution. However, the distribution of intensity among the values of n', as observed by Fowler (M.N. Roy. Astron. Soc., 70, 484, 1910) and by Baldet (*loc., cit.*), is definitely a high temperature distribution, while the quite different distribution observed in a helium mixture, by Merton and Johnson (Proc. Roy. Soc., A, 103, 383, 1923), is equally definitely a low temperature distribution.

The high pressure CO bands found by Fowler (*loc. cit.*) form a single n'' progression ($n'' = 0$ to 5, while $n' = 0$, presumably). Within the very large limits of error, this set of final states is the same as the set of initial states of the comet-tail bands. Much more accurate data for the high pressure bands are needed in order to settle the question definitely, but the experimental conditions needed for the production of these bands favour the identity, I believe.

The third positive group is well worth a detailed remeasurement and quantum analysis, the successive minima observed by Wolter (*Zeit. wiss. Phot.*, 9, 36, 1911) doubtless corresponding to the origins of successive bands of a sequence. Accurate data (by Wolter) are available now only for the six heads of the first band of each sequence. The resulting $f(n'')$ is closely similar to that of the common nitrogen progression, but is definitely not the same.

The triplet bands measured by Merton and Johnson (*loc. cit.*) have the same unusual intensity distribution noted for the comet-tail bands ($n' = 0$ to 6, $n'' = 0$ and 1 only). The single resulting n'' interval ($\Delta\nu = 1714$) is practically identical with the corresponding interval for the third positive group, but no conclusion can be drawn without known values of other intervals. The $f(n')$ for this group is not related to any other.

The fourth positive group is very extensive and is noteworthy in corresponding to a very *slow* initial vibration ($\Delta\nu = 500$, approx.) and a very *rapid* final vibration ($\Delta\nu = 3000$, approx.). No other new relations between the progressions of the various carbon groups have been found, so that at present no further inferences as to the identity of the emitters can be drawn from this line of evidence.

RAYMOND T. BIRGE.

Department of Physics,
University of California,
June 8.

Sensitive Jets and Flames.

MANY types of sensitive flame have been described from time to time, and measurements of the range of pitch and of the pressure at which they are sensitive have been made, but I have not seen any quantitative record of the variation of the length of such a flame or jet. In this connexion some experiments made recently by Mr. E. Tyler and myself with jets of coloured water flowing into still water seem to be relevant. At a certain distance from the nozzle from which it is issuing the stream suddenly breaks down into general turbulence. Measurements of the continuous length of the jet, L, under different heads of pressure were made, and hence a curve of velocity of efflux, V_0, against L obtained. Two of these are shown in Fig. 1; they have the form of rectangular hyperbolæ; a similar curve was obtained with a jet of air mixed with smoke.

The shape of these curves can be accounted for on similarity principles. The point at which the jet breaks up is taken to be that at which the Reynolds' criterion VD/ν (D diameter of jet and V = mean velocity at this point, ν = kinematic viscosity) has reached that value at which the motion becomes turbulent. If the initial velocity at the nozzle be increased, the critical velocity, V, will be reached at a point nearer the nozzle; L will therefore become smaller as V_0 is increased. The effect of altering D_0 or ν may likewise be predicted. Introducing L into the "criterion" in the form of a function of D_0/L,

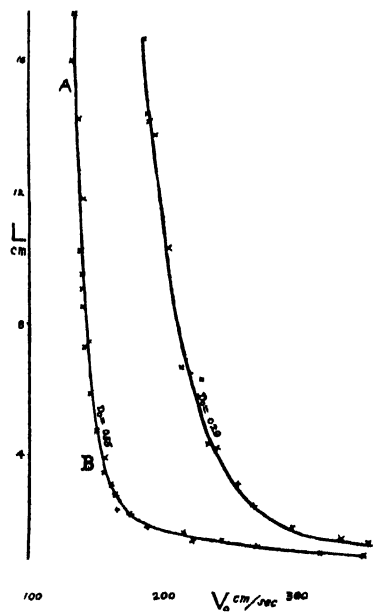

FIG. 1.

D_0 being the diameter of the nozzle, one obtains $V_0 = K\frac{\nu}{D_0} \cdot f\left(\frac{D_0}{L}\right)$. Expanding $f\left(\frac{D_0}{L}\right)$ as a linear function, and retaining two terms only of the expansion, since D_0 is small compared with L in sensitive jets, we get $V_0 = K_1\frac{\nu}{D_0} + K_2\frac{\nu}{L}$, that is, LV_0 is a constant for a given nozzle and gas.

Further, Kohlrauch and also Krüger have shown (*Ann. der Phys.*, 1881 and 1920) that, in a jet issuing from a circular nozzle, vortices are produced periodically with frequency n, given by V/nd a constant, d being a linear dimension dependent on the bore of the nozzle. The jet should respond most readily to tones of this frequency, or sub-multiples thereof, and a high-velocity jet to sounds of high frequency. When a jet of gas is ignited, the combustion complicates matters, as the visible part of the jet lengthens at first as the velocity increases; but Rayleigh showed that, over the range for which they are sensitive, such flames behave in most particulars like unignited jets, the progress of which is made visible by smoke. Experiment showed that a sudden small increase in the velocity of the gas feeding a sensitive flame brought the turbulent point—visible as a "flare"—nearer to the nozzle.

The other common experience with sensitive jets

and flames, that they are sensitive only over a small range of gas pressure, and, therefore, of efflux velocity, is shown by the curves and by theory. It is a consequence of the hyperbolic relation between L and V_0, that at a certain value of the latter a small increase in velocity due to aerial disturbances causes a large change in length, so that in using a sensitive flame it is necessary to work on the part AB of the curve.

E. G. RICHARDSON.

University College,
London, W.C.1.

Science and Intellectual Freedom.

ON my return from abroad a few days ago, I found your letter of June 30 awaiting me. Allow me to express regret that circumstances prevented an earlier reply. Perhaps it is not too late for a brief statement of opinion on the controversy raised by the trial of Mr. J. T. Scopes of Tennessee.

Two questions of supreme importance have emerged: Liberty of scientific research; and the bearing of the doctrine of evolution on religion.

It is certainly an astonishing thing that, after the history of human thought during the last two hundred years, the legislatures of States which lay claim to some degree of civilisation should be found restricting science within limits prescribed by special interpretations of Holy Scripture. It does not seem to have occurred to these good people that, on such conditions, scientific research becomes impossible. Nor do they see that they are seeking to restore that very state of things which delayed the advance of human knowledge for centuries. They have still to learn that truth must be sought for its own sake.

Again, they are mistaken in thinking that the doctrine of evolution is anti-Christian. To my judgment, exactly the opposite is the fact. Evolution teaches the unity of all creation: it reveals an organic relationship among all living things, making us all akin: it enables us to form a conception of the Creator as One who is not remote from us in some transcendent sphere, but is Life of our life and continually at work in the universe. These are Christian ideas: they may be said to be among the essential ideas of Christianity.

As to the early chapters of Genesis, their sublime accounts of the beginnings of things lose all their true value if we regard them as scientific statements. They are full of meaning if we view them as the expression of fundamental religious principles in the language and imagery of the age to which they belong.

CHARLES F. ARMAGH.

THE Tennessee trial has given the readers of NATURE an amusing motley of opinion, but are we not, perhaps, treating the rejection by "Main Street" of the much over-advertised Mr. Scopes too seriously and missing the real significance of the occasion? Is not a lesson of profound social importance behind it all? We are talking glibly of interference with "freedom of thought." Is there any such thing—even in the ranks of our boasted "science"? Are not the teachers, for the most part, just repeating what they have been told, without exercising any thought? Is the Pauline injunction, *Prove all things, hold fast that which is good*, in any way followed? If it were, societies would have no difficulty in meeting costs of publication. Whatever may be the case in biology, it certainly is not on the physical side. We mostly use the "Main Street" method but are at the disadvantage that we have no bible holding our faiths which can be put into the hands of the public. Consider our Press, consider our politicians—the Cabinet, even our Public Schools, are not all these located in "Main Street"?

Scientific method, the method of proving all things, is only known to and used by the few who are real makers of knowledge—science factors. The scientific, like all artistic gifts, we must recognise to be an "inborn error of metabolism." Our text-books are as dogmatic as is the great book used of "Main Street." This not only has the advantage of great beauty of language but also a concealed authority behind it—Man's innate belief in a superior being—which we cannot command. The "Aunt Susans" who teach it do so with a thoroughness and sense of conviction which we can in no way match.

Any one who wishes to gain some inkling of its power should study Ruskin's "Modern Painters"—the work of an arch critic gifted with a mind of transcendent power, not an obscurantist. The practical achievements of the scientific mind are blinding us to our failure to teach and use scientific method in our ordinary affairs. We need be in no hurry to force our speculations into the schools—better not. We do need to teach all to respect our method, though, maybe, it is that used only in the best circles. We need, on all possible occasions, to make clear, to ourselves and others, the significance of the assertion, to which Sir Bryan Donkin and Sir E. Ray Lankester directed timely notice recently, made by the late W. K. Clifford—*It is wrong always, everywhere and for any one to believe anything on insufficient evidence*—let alone teach it as truth, as is so often done in our classes. We have gradually to repave "Main Street" with such doctrine: our difficulty is that most of us are born to live in it—as it is. Yet when Bishops can write as do those of Birmingham and Durham, we need not altogether despair—though these also are probably "metabolic errors."

HENRY E. ARMSTRONG.

Changes in the Ultra-violet Absorption of Gelatin.

IN some investigations on the ultra-violet absorption of gelatins, we have discovered that the absorption spectrum changes in a characteristic manner according as the gelatin is on either side of the iso-electric point, indicating that the different P_H values are associated with a definite change in the chemical constitution. Taking the iso-electric point as 4·7, when the P_H value of a gelatin rises above this, there is a characteristic increase in absorption from about 3500 Å.U. towards the red end, while with a fall in P_H there is an increase in absorption in the region of *shorter* wave-lengths. These very marked changes in ultra-violet absorption would appear to provide a valuable means of investigating minute changes in the constitution of gelatins.

T. THORNE BAKER.
L. F. DAVIDSON.

The Oogenesis of Lumbricus.

REFERRING to Dr. Graham Cannon's letter in NATURE of July 18, I may be permitted to remark that the reason why it is not only inadvisable but even unprofitable to discuss oogenesis in general, on the basis of work done on a single species of one order, is that, unlike the chromosomes, the Golgi bodies and mitochondria are variable in behaviour in different orders, and even within a single family. This is the most important fact which recent researches on the cytoplasmic inclusions have revealed, and, of course, throws a clear light on the question of the status of these bodies in heredity.

J. BRONTË GATENBY.

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Dublin.

Regions of Tension and Continental Drift.[1]

By Dr. J. W. EVANS, F.R.S.

IN many areas the earth's crust has been subjected to compression manifesting itself in folding, cleavage, thrust-faults, and certain types of igneous activity. Such compression may prevail over an extensive region, or may be of a purely local character. In the former case, it is usually attributed to the progressive contraction of the earth's interior, although this has been disputed by some authorities. In the latter, it is merely an incident in the development of more extended structures. The results of compression have long been studied, but comparatively little attention has been given to the occurrence of tension in areas where it has left evidence of its existence in the form of joints, normal or slip-faults, occasionally replaced by monoclinal folds, dykes, and other characteristic igneous phenomena.

. . . . . .

The distribution and direction of the jointing, the slip-faulting, and the dykes of western Europe of post-Hercynian date, are all due to tension, producing stretching, fracture, and separation, and together they imply relative movement, or drift, in the rocks with which they are associated.

The most prevalent strike of these fractures in the British Isles and western France is from north north-west to south-south-east, implying a drift from east-north-east to west-south-west, or *vice versa*. However, in the Devon-Cornwall peninsula there appears to be a general downward slip to the south-west, modified later, it would seem, by a movement towards the north-west. In Skye the faults posterior to the igneous activity seem to show a similar change in the direction of the tension. In the north-west of Connaught, of Ulster, and of Sutherland the faults appear to strike as a rule north-east and south-west, implying the presence of a drift to the north-west, but in western Ulster, and in Mayo, this appears to have been preceded by an earlier tension directed towards the south-west or south-south-west, indicated by the north-west and south-east or west-north-west and east-south-east basic dykes.

Closely connected with the drift of the surface-blocks must be the stretching of the presumably plastic zone beneath. Indeed, it would seem that it is this stretching or slow flow which is the immediate cause of the minor fissuring of the crustal rocks. The blocks which are thus formed are then so disposed relatively to one another as to cover, so far as possible, the extended space. This may happen in two ways:

In the south-western peninsula of England and other localities the fault-fractures had originally considerable hade, usually directed to the region of weakness, and the extension took place by the downward slip of the block on the upper side of each fault.

In Skye and elsewhere the hade of the fissures seems originally to have been practically vertical; but the blocks between the faults were afterwards inclined, so that the beds which were formerly nearly horizontal now dip in a direction opposite to the faults. In this case the covering of the extended area is effected by the tilting of the blocks. It is probable that in such cases the underlying magma has, it is suggested, flowed in the direction of the hade of the faults.

The volcanic activity in the west of Scotland and in the north-east of Ireland commenced, on the evidence of plant-remains, early in the Eocene, and may have continued for a great portion of that period. The faulting which has been described must have been of still later date. It is indeed impossible to fix any limit to the continuance of the tension. How far it was present in Mesozoic times we cannot say with certainty, but it apparently had a beginning in the Permian.

The drift towards the west (south-west or north-west) in western Europe seems to have been widespread, though greater in some regions than in others, but everywhere east-and-west distances appear to have been increased.

We are not in a position to estimate the total amount of this extension. It could only be calculated if we knew the width of each joint, the hade of each fault-plane, the direction and amount of the movement in it, and the thickness of each dyke. It does not, however, seem likely that the total relative change of distance between Central Europe and western Ireland has exceeded, say, 6 to 12 miles (10 or 20 km.) since Triassic times.

The true significance of this drift becomes evident on examination of a depth-chart of the North Atlantic. It is at once seen that the approximately north-west and south-east strike of different forms of fracture that is so prevalent in the British Isles and western France is related to the ocean-deep of which the north-eastern boundary runs roughly south-east and north-west, parallel to the French coast of the Bay of Biscay, out into the open Atlantic; and that the north-east and south-west strike which is found in the north-west is apparently similarly related to the edge of the trough that extends from south-west to north-east beyond the Hebrides. The drifts to the south-west and north-west seem to be towards these abysmal regions of deep water, the crustal blocks being carried forward by the flow of the plastic region beneath. The formation or widening of these deeps cannot have greatly preceded the drift towards them, which seems to have culminated in Tertiary times. From what has been stated, there would seem to be reason to suppose that the development of the oceanic deep on the north-west of the British Isles was of a later date than that on the south-west.

The doctrine of the balance or "isostasy" of different areas of the earth's surface, which now seems to be firmly established, requires that the continents should be composed of lighter materials than the floor of the deep sea. The former consist mainly of granite (including the foliated granite more usually described as granitoid gneiss) and of sedimentary rocks which, though widespread at the surface, form only a comparatively small part of the whole. These are together conveniently referred to as sial. The ocean-beds must, on the other hand, be composed of heavier rocks made up of the silicates of iron, manganese, magnesium, and

[1] From the presidential address delivered to the Geological Society of London at the anniversary meeting on February 20.

calcium -the sima of Suess. This conclusion is confirmed by the greater "magnetic permeability" of the ocean-floor compared with the continents, indicating in the former the presence of ferrous oxide.[2]

The distinction between sial and sima appears to be the result of a primeval magmatic differentiation of the outer zones of the earth into a lighter acid portion consisting mainly of silica with alumina, the alkalies, and much water and other volatile constituents -that is to say, the typical magma of acid rocks such as granites and rhyolites -and a heavier basic portion corresponding to the magmas of dolerites and basalts, passing doubtless below into that of the still more basic peridotites.

There seems to be no doubt that Suess was right in supposing that the sima extends everywhere below the sial of the continents. There is, however, considerable difference of opinion as to the thickness of the continental sial. Wegener[3] supposes it to be so much as 63 miles (100 km.). This is founded largely on Hayford's level of isostatic equilibrium or uniform density, which he placed at a depth of 71 miles (114 km.). It was afterwards reduced by Bowie to 60 miles (96 km.), which, however, appears to represent the depth of the sial forming the downward extending folds of the Rocky Mountains. Doubtless in the Himalayas it would be still greater, but in plains and plateaux the thickness may perhaps range from 9 to 40 miles (15 to 64 km.).[4] It would depend on the altitude of the land and on the density of the sial. Nor is the depth to which the sial extends necessarily the same as that of the depth of uniform density. In the older parts of the continental shields the latter is probably considerably less than the former.

The idea that ocean-depths are the result of foundering is wholly opposed to the doctrine of isostasy, for it implies that the rocks which form the floor of the oceans are of the same composition as those of the neighbouring continents.

The only alternative is to conclude that the continental masses of sial can, under the action of continuously applied external forces, slowly drift through the sima, and that they have thus moved apart and left the ocean-deeps between them.

The magma of the granite of the sial must, on account of the large amount of water and other volatile constituents that it contained, have cooled to a comparatively low temperature, say 600° C., before it crystallised. These constituents were, however, eliminated and lost, so that it would thereafter require a much higher temperature to melt or even soften the rock, and the sedimentary constituents of the sial would (as a rule) prove equally refractory.

The basic rocks that constitute the sima, especially if they are rich in iron, are on the other hand less affected by the loss of volatile constituents. We may therefore expect that, at a temperature corresponding to comparatively moderate depths, they would become to some extent plastic.

The principle of isostasy appears in fact to depend on the circumstance that, given sufficient time, by no means very long from the geological point of view, the sima acts as a whole as a fluid in which the sial floats, to use Airy's simile, like a log in water, or in Wegener's words, like ice-floes in the sea, although, it need scarcely be said, the viscosity of the sima (even at a fairly high temperature) is many thousands of times that of water. There is therefore nothing surprising in the blocks of sial making their way through the sima, accompanied, it may be, by crystallised sima adhering to their lower surfaces.

It is to the major fissures of the earth's crust, which are represented by the ocean-deeps, that we must look for the fundamental cause of igneous activity in regions of tension. As the fissure opens, the underlying sima magma will rise, in order to re-establish a condition of isostasy. This will be facilitated by the fact that the accompanying release of pressure will render the magma fluid, and at the same time cause it to expand. This expansion will be all the greater, on account of the volatile constituents in the magma. Its density will of course diminish correspondingly, and it will rise higher in the fissure than it would otherwise have done.

In the course of time, however, a large proportion of the volatile constituents will escape, crystallisation commence, and the density increase, so that the column will sink to a certain extent.[5]

Some idea of the depth from which the sima of ocean-deeps rises can be gathered from the temperature of igneous magmas. Dr. H. H. Thomas, from an examination of the metamorphism of the xenoliths in the Loch Scridain magma-reservoir, arrived at the conclusion that it was initiated at a temperature of nearly 1400° C.[6] This figure rests on experiments with dry metals, and must, he thinks, be reduced, if the presence of water under pressure be taken into account. Some heat may have been lost while the magma was rising, and during the course of its intrusion; but there may have been a slight accession of temperature from oxidation or radio-activity. We may, however, assume for purposes of illustration that the temperature in the original position of the magma was in the neighbourhood of 1400° C.

According to the calculations of Prof. L. H. Adams, which appear to rest on a sound basis,[7] this temperature would be ordinarily found at a depth of about 72 miles (115 km.). This actual figure is, at best, a conjectural estimate; but it would seem probable that some parts at least of the magma of igneous intrusions must come from a depth that cannot have been very much less. It would therefore seem that the formation of these major fissures presents the most probable means by which material from great depths has reached the neighbourhood of the surface, a conclusion which is of some importance in considering the source of the metalliferous ores.

Before the opening of a fissure, differentiation at such depths would be impossible, on account of the extreme viscosity of the magma under heavy pressure, but the release of pressure due to the opening of the fissure

[2] A. Wegener: "The Origin of Continents and Oceans," 1924, pp. 32-33.
[3] *Ibid.* p. 37.
[4] H. S. Washington's estimate is from 15 to 20 km. (9 to 12½ miles), Journ. Washington Acad. Sci., vol. 14 (1924), p. 437.
[5] An incidental effect of the formation of rifts would be the lowering of the level of the sea. The area of the deeps lying below 15,000 feet (4573 metres) is about a third of that of the whole ocean. If, then, a tenth of these came into existence as rifts about the same time, in consequence of an average sinking of 7500 feet (2287 metres), the surface of the sea would be lowered by about 250 feet (76 metres). These figures are, of course, only intended to show that the effect would not be negligible.
[6] Q.J.G.S., vol. 78 (1922), pp. 250-54, and "Island of Mull," Mem. Geol. Surv., 1924, p. 278.
[7] Journ. Washington Acad. Sci., vol. 14 (1924), p. 468.

would result at once in an increase of fluidity. The first differentiation would be, in all probability, a repetition of the primordial process of differentiation into basic and acid magmas already mentioned, for the sima would appear to be capable of yielding another but smaller crop of an aqueous acid magma. This would be followed by further differentiation by crystallisation due to cooling as well as to loss of volatile constituents, with the result that ultimately a wide range of igneous rocks would be evolved.[8] Before, however, differentiation had advanced very far, a series of lateral intrusions from the major fissures would have commenced. The flow of the deep subcrustal sima towards the fissure would cause a temporary sinking of the adjoining crust, simultaneous with the rise of the magma in the fissure, with the result that, for a portion at least of the length of the column filling the fissure, the pressure of the magma would exceed that of the surrounding rock, so that intrusion would take place.

As differentiation proceeded in the intruded magma, the progress of the segregated acid magma would be retarded by local viscidity, caused by the loss of a portion of the volatile constituents and by cooling at the surface of contact with the adjoining rock. This would not be the case with the ultra-basic and basic magmas below it (which would form by far the greater portion of the whole), as they contain less volatile constituents, and are less dependent on them for their fluidity. The ultra-basic and basic magmas would, therefore, progress more rapidly than the acid magma. In so doing they would let down the still fluid portion of the acid magma above them until the latter reached the level of their flow. Here it would be protected from loss of volatile constituents, and the temperature of the surrounding rock would by this time have become little less than that of the magma itself. The acid would therefore follow the basic magma in the channel of intrusion, a succession which corresponds very closely to the order of intrusion of plutonic magmas in the west of Scotland and at the Lizard.[9]

How far this lateral penetration will extend, and what form it will take, depend on the nature and structures of the rocks, and the earth-movements that may supervene. A magma may travel a considerable distance horizontally, or with a gentle inclination upwards—without any manifestation, other than the filling of fissures at right angles to the prevailing tension—until it meets with an obstacle, such as deeply-rooted mountain-folding, when it may form a tumefaction in the nature of a laccolith which will become a centre of igneous activity, and give rise to radiating and concentric structures as well as plutonic rock-masses, or it may well out in fissure-eruptions. Its progress and manifestations will be due partly to the hydraulic pressure to which it is subjected, and partly to the expansive force of its volatile constituents, and these will be assisted in some cases by faulting, bringing the magma into contact with rocks under less pressure, into which it will penetrate along joint- or fault-planes.

Of all these manifestations of igneous activity, it is the occurrence of parallel dykes that is usually the most widely extended, both in space and in time, and affords the most satisfactory evidence of the area throughout which a subterranean magma has spread—so far at least as it is accompanied by a prevalence of tensional conditions above it

[8] That the first stage of the differentiation of igneous rock is into an acid and basic magma is, to my mind, abundantly proved by Dr. W. A. Richardson and G. Sneesby's analyses of the frequency of igneous magmas of different silica percentages. This clearly shows two distinct peaks, one acid and the other basic, *Min. Mag.*, vol. 19 (1922), pp. 303-13.

[9] I have long advocated such an explanation of the order of intrusion of plutonic rocks in my lectures at the Imperial College of Science and Technology. I may add that the ultra-basic magma would move more rapidly than the basic, for, on account of the excess of the density of the basic magma over that of the adjoining rock, the maximum difference of pressure will occur below it.

(*To be continued.*)

The Nutrition of Cattle.

THE subject of the feeding of cattle assumes importance from the large part their products play in human dietaries. An accurate knowledge of their metabolism and nutritive requirements, apart from its intrinsic scientific interest, may lead both to more economical methods of feeding and at the same time to an improvement in the quality and quantity of the products, meat and milk, obtained from them. In this survey a brief account will be given of some recent work on the energy, protein and mineral requirements of these animals, with special reference to the production of milk in dairy cows.

The measurement of the energy requirement resolves itself into the problem of estimating the heat given out by the animal, since to maintain the body in equilibrium a similar amount of energy must be taken in in the food. The output of heat can be measured directly by placing the animal in a calorimeter, or chamber in which the heat emitted is measured by the amount absorbed by current of cold water circulating through the chamber; the analysis of the ingoing and outgoing air at the same time will give the consumption of oxygen and output of carbon dioxide during the experimental period. The method requires the use of elaborate apparatus, so that in practice the indirect method of determination of the heat output is more frequently employed. In this the output of carbon dioxide and consumption of oxygen are determined over a short period, and from these data, together with the value of the respiratory quotient, *i.e.* the ratio of carbon dioxide produced to oxygen consumed, a value can be found for the heat production which is sufficiently accurate for most purposes. The respiratory quotient conveys information as to the types of foodstuffs which are being oxidised in the body, and this information is essential since the heat produced varies according to the type of foodstuff, protein, fat or carbohydrate utilised.

The problem of estimating the heat output in the case of cattle has been still further simplified by W. W. Braman (*J. Biol. Chem.*, 1924, vol. 60, p. 79): the only data required are the output of carbon dioxide and the amount of food taken. In a large number of experiments he has found that the ratio heat/carbon dioxide is highest in starvation and falls steadily with increase in the amount of food eaten, the heat production increasing more slowly than the carbon dioxide formed.

The change is due to the fact that in starvation most of the heat produced comes from the oxidation of fat, which has a high calorie value, whereas the food is chiefly carbohydrate with a relatively low calorie value. These experiments enable an investigator, by estimating the carbon dioxide production and noting the food consumption, to determine the approximate heat output by applying the formula given by the author or by reading from the graph relating the ratio heat/carbon dioxide to the food consumption, which is approximately a straight line. The heat output thus calculated agrees closely with that actually observed in a calorimeter.

A more elaborate, but more accurate, indirect method of estimating the heat output of cows has been utilised by J. A. Fries, W. W. Braman, and D. C. Cochrane (U.S. Dept. of Agricult., Bull. No. 1281, 1924). The method depends on the fact that in an animal which is maintaining its weight, the heat output must equal the energy of the food actually utilised by the body during the experimental period. Of the food taken, some is not absorbed and some is excreted in an incompletely oxidised form. The digestibility of the food is usually estimated by taking the difference between the amount eaten and the amount excreted in the fæces, but the authors point out that in cattle, bacteria in the intestine play an important part in digestion. At the same time, one of the products of their fermentative action is a gas, methane, whilst the process itself is accompanied by an output of heat. The methane produced has been estimated in the respiration calorimeter, and the heat of fermentation from the ratio of methane to carbon dioxide in the products of fermentation. The results show that whereas the digestible portion of the food appears to be about 66 per cent. of that taken by estimation by the usual method, by taking account of the above two factors also, only about 50 per cent. of the food consumed is actually absorbed and available for energy and heat production. The actual energy of the food was determined directly by the bomb calorimeter, and thus the actual energy available to the body is known. Nearly all this energy is available for maintenance, growth (or increase of protein or fat in the body), work, and the production of milk, about 10 per cent. being lost in the processes of digestion and in the formation and elimination of the excreta. The authors have compared the heat production calculated from the available energy of the food with that actually observed during the same period in the respiration calorimeter and have obtained a very good agreement. The result indicates, in their opinion, that this method of "indirect calorimetry is sufficiently accurate for purposes of research in the feeding of farm animals."

Of the energy available to the body in the food, about half is required to maintain the body-weight constant: the remainder can be utilised for increase in body weight or for milk production. The data show that a larger proportion of the energy available is found as energy in the milk than in any increase of body weight; the process of milk formation appears to be more economical than that of body tissue and fat formation. The result suggests that the food materials are available directly for milk formation and do not have to become body tissue first and milk later. Of the available energy, 90 per cent. or more can, under certain conditions, be utilised in milk production.

It is of course essential that the conditions of the experiment should be kept as constant as possible in different experiments. One factor which may introduce a disturbing element is the relative amount of time spent by the animal in the standing and lying positions. This subject has been considered in more detail by J. A. Fries and M. Kriss (*Amer. Journ. Physiol.*, 1924, vol. 71, p. 60). They found that allowance must be made for the taking up of heat by the floor on which the animal lies in the respiration calorimeter, this heat being afterwards given up when the animal stands, making the heat output of this period too high. The magnitude of this error can be ascertained by estimating the carbon dioxide output and assuming that the ratio heat/carbon dioxide is a constant. Making this allowance, it was found that the heat output of a 400 kgm. cow increased by about 25 calories per hour on standing. The authors recommend that the heat production be calculated to a standard day of twelve hours lying and twelve hours standing, so as to obtain uniformity in the expression of the results obtained by different observers.

It is of interest to note that in the later stages of gestation, a cow appears to require about 2 per cent. more food for maintenance than a non-pregnant animal of the same weight.

The utilisation of protein in milk production has been considered by J. A. Fries, W. W. Braman, and M. Kriss, and also more recently by E. B. Forbes and R. W. Swift (*Journ. of Dairy Science*, 1924, vol. 7, p. 11, and 1925, vol. 8, p. 15). The two sets of experiments agree fairly well in showing that in well-fed animals the utilisation of protein for milk production is about 40 per cent. of that available for this purpose (that is, the digestible protein of the food less that required for maintenance). With decrease in the protein intake, however, the former authors found that a larger proportion of the available protein, up to 85 per cent., became available for milk production, since the nitrogen excretion falls *pari passu* with the drop in nitrogen intake, whilst the nitrogen in the milk remains almost constant. With a higher percentage utilisation, however, the amount of milk produced tends to fall off, being increased again with increase in the protein intake. The optimum nitrogen intake was an amount of available nitrogen about 10 per cent. greater than the nitrogen found in the milk produced. The animals maintained their weight, whereas with a larger protein intake the animals gained in weight by the deposition of fat, together with an increased formation of body tissue. The fact that with low nitrogen intakes the quantity of milk produced tends to fall off in a cow producing a large amount daily, suggests that the level of optimum intake of nitrogen as regards the nitrogen of the milk is not the optimum level for the production of a large quantity of milk, which contains both fats and carbohydrates as well as protein, and therefore that the animals should be well fed, if the best results as regards milk production are to be obtained.

In addition to the proteins, fats and carbohydrates present in milk, account should also be taken of its vitamin and mineral content in estimating its quality. Ultimately these factors come from the food, in which

they should therefore be present, but the amounts passed into the milk may be greater than can be absorbed in the food, leading to a depletion of the animal's own stores. This appears to occur especially in the case of the calcium of the milk. During liberal milk production on winter foodstuffs there may be a definite loss of calcium from the body; on fresh foodstuffs this loss is less or may be absent (E. B. Forbes, Washington Government Printing Office, 1924). This effect is quite probably to be related to different amounts of vitamin A present in the dry and fresh green foodstuffs, but it seems to be clear that the cow should be encouraged to store as much calcium as possible in her body during her dry periods by the giving of calcium, for example, in the form of bone meal, in addition to an adequate supply of fresh green foodstuffs. It is possible also that the addition of sodium phosphate to a dried ration may increase the milk yield after parturition, suggesting that this food may be deficient not only in calcium but also in phosphorus, or that the availability of these elements present in the food is impaired by a deficiency in the fat-soluble vitamin A.

The general result of all these investigations is that a dairy cow should be fed on an abundance of fresh green food, containing a supply of protein, etc., which is sufficient to maintain both the quantity of the milk produced at a high level as well as its protein, mineral and vitamin content. If this be done, the supply of energy will certainly be adequate also.

Current Topics and Events.

SCIENTIFIC aspects of national life were honoured by the attention and interest given to them on two occasions last week by the King and Queen. On the afternoon of Wednesday, July 22, their Majesties visited the Royal Society and examined with much interest many of the exhibits arranged for the annual conversazione of the Society held on the evening of the same day. They were also present at a lantern lecture by Mr. F. E. Smith, Director of Research at the Admiralty, upon the subject of navigational devices. On Thursday, July 23, the King and Queen visited the Royal Observatory, Greenwich, in connexion with the celebration of the 250th anniversary of the foundation of the Observatory. They were received in the Octagon Room by Sir Frank Dyson and conducted round the Observatory. A number of members of the Board of Visitors and delegates from abroad of the International Astronomical Union had the honour of being presented to their Majesties.

A SLIGHT anticipation of dates was made in the celebration of the 250th anniversary of the Royal Observatory, Greenwich, on July 23, in view of the presence in England of the large body of foreign astronomers who had come for the meeting of the International Astronomical Union at Cambridge. Actually the foundation stone of the Observatory was not laid until August 10, 1675, and Flamsteed did not come into residence until July 1676. However, an exact adherence to dates is seldom possible in these commemorations, and the circumstances amply justified the anticipation. The celebration was honoured by the presence of the King and Queen, this being the second visit of a British sovereign to the Observatory since its foundation; the previous one was by George III. Although Charles II. showed so much interest in its foundation, there is no record extant of his having actually visited it. Their Majesties were conducted round the principal domes by the Astronomer-Royal, and later expressed the interest and pleasure that they had derived from the visit. It may be well to remind younger readers that our "Sailor King" has been through the complete course of a naval officer, and commanded a destroyer, so that he has a full knowledge of nautical astronomy. The prime object of the foundation of the Observatory was to aid navigation; this end has been kept in view up to the present, as we see in the rating of chronometers, the dropping of time-balls at Greenwich, Deal and elsewhere, and the continued observation of the positions and motions of sun, moon and fundamental stars. The evolution of the chronometer could be traced by the visitors, since the three earliest timepieces of Harrison were exhibited. Two of them have lately been restored, and were actually going, so that they could be compared with a large number of modern chronometers.

THE sudden death on July 26, at the age of sixty-five years, of Mr. W. J. Bryan, orator, politician and Fundamentalist, has come as a shock to all who followed the course of the trial at Dayton, Tennessee, of Mr. J. T. Scopes, who was convicted of breaking the State law against teaching the truth of evolutionary theory. Mr. Bryan conducted the prosecution ably, but during his examination by the defence, he made some remarkable statements as to the precise dating of events in the Biblical record. The Flood was fixed as probably having taken place in 2348 B.C., while the confusion of tongues at the Tower of Babel was assigned to 2230 B.C. Mr. Bryan conceded that the six days of creation must be regarded as periods of time. A further admission that the creation might have continued for millions of years may perhaps open the way to some sort of accommodation with geological evidence; it might even admit of an adjustment with the one hundred and thirty thousand years or so which at least seem to be demanded for man's existence on this earth by the evidence of the stone implements of Lower Palæolithic Age—to say nothing of those of earlier date. In putting to Mr. Bryan the evidence for the existence of civilisation in China before the Bible creation 6000 years ago, counsel was perhaps on somewhat uncertain ground, although the Shu-king begins with a record of the days of Yaou (2355 B.C.) and Shun, who brought to a close the second patriarchal dynasty of China, founded by Foh-hi in the year 2943 B.C. On the other hand, Mr. Bryan's fellow-countryman, Mr. Pumpelly, estimated that the beginnings of the neolithic stratum which he excavated at Anau in Turkestan dated back somewhat before 8000 B.C.

ALTHOUGH archæologists are inclined to regard Mr. Pumpelly's dating at Anau as too early, and display the same hesitation in accepting the very high dating of M. de Morgan for the early civilisation he found at Susa, the results of recent excavations in Mesopotamia are of considerable interest in relation to the question of early datings. The work both at Kish and at Ur and the neighbouring site of Tel el-Obeid in the last two or three years has considerably extended the period of antiquity of which the dating may be considered to have been fixed with a reasonable degree of accuracy. At Kish, for example, an inscription of Lugul-ud, king of Kish prior to 3100 B.C., has been discovered, and below the floor of the building in which it was found lie 15 feet of debris, which on a conservative estimate would place the early occupation so far back as 4500 to 5000 B.C. At Tel el-Obeid a marble socket of a gate has been found which bears the inscription of a king of the first dynasty at Ur. According to Babylonian tradition, this dynasty was the third to rule after the Flood. This discovery vindicates the existence of the dynasty, which had hitherto been regarded as mythical like its two predecessors, and if the dead reckoning estimate of its beginning in 4000 B.C. is too high, 4000 B.C. or 3900 would be a not unreasonable date. In Egypt, as is well known, astronomical data are available, though gaps in the records give some uncertainty to early dates. On the lowest estimate, however, the accession of Menes, the first king of the First Dynasty, is assigned to 3400 B.C., while the calendar was introduced in 4241 B.C.

IN a speech delivered at a luncheon of the British Optical Instrument Manufacturers' Association on Thursday, July 23, Mr. F. Twyman, the president, gave an instructive and encouraging review of the present technical condition of the optical instrument industry of Great Britain. It is well known that the industry has suffered enormously during the financial and commercial decline of the past few years. It is not so well known, however, that these years have been for the industry a period of experiment and development, of prolonged and successful effort towards improving its products, inventing and putting new products on the market, and increasing its equipment for producing. The experimental and research work carried out continuously by members of the industry has resulted not only in an increase in the range of products, but also in developments of real scientific importance. From many examples quoted, it would seem probable that most of the research of the world, in certain fields of prime importance in modern physics, is being done with British-made instruments. The growing use of optical instruments for the control of industrial processes, and for maintaining a high and uniform standard of quality in the productions of important industries, has undoubtedly been encouraged by the fact that these industries have been able to obtain from British optical firms suitable instruments, often very complex and designed with great inventive ability to achieve the particular end desired. The technical advances and achievements in regard to the design and production of optical instruments, enumerated by Mr. Twyman, give evidence that the industry is active in invention and development and in the application of the results of scientific research conducted by it or on its behalf. The result is seen in its ever-improving position in the race for technical supremacy.

A MEETING, called by the Optical Society to consider the desirability of arranging an Optical Convention in 1926, was held at the Royal Society of Arts on Tuesday, July 21. Sir Herbert Jackson presided, and there were present representatives of all branches of the optical and scientific instrument industry, together with representatives of cognate scientific and technical societies, and others interested in the theory and practice of optical science and in the use of optical instruments. The chairman intimated that the object of the proposed Convention was to bring before the notice of the scientific and general public the many and important developments which had taken place in recent years in British optical apparatus and instruments, and to show that the products of the optical glass industry and the optical instrument industry of Great Britain were well able to compete with those of foreign competitors. It was for the manufacturers to decide whether the time was opportune for holding such a convention. Several of those present spoke in favour of the proposal, and it was resolved that a British Optical Convention be held at the Imperial College of Science and Technology, South Kensington, in July 1926, and that a guarantee fund of 2000*l.* be raised, if possible, before October 1, 1925. It was announced that the Council of the Optical Society had already agreed to contribute a sum of 200*l.* towards such a fund. Thereafter, a general committee consisting of those present was formed, and an executive committee nominated, with powers to make the necessary arrangements. Detailed proposals will be published with regard to the scope and scheme of the Convention as soon as the executive committee has considered the various matters involved.

THE second of the annual conversaziones of the Royal Society was held in the Society's rooms on July 22. The majority of the exhibits arranged for the occasion were also shown at the first conversazione (NATURE, May 23, p. 819). Among the fresh exhibits were six models of early locomotive engines, pieces of apparatus used by Sir William and Sir John Herschel and a replica of an early Egyptian astronomical instrument. This instrument, the "Merkhet" of the Egyptians, and the "ὡρολόγιον" of the Greeks, was used to lay out a meridian line and to note the meridian passage of stars for determining the time in connexion with temple ceremonies. The original in Berlin dates from about 700 B.C., but the instrument was in use very much earlier. These exhibits were shown by the Science Museum. Mr. W. Bateson and Mr. R. J. Chittenden (John Innes Horticultural Institution) showed examples of root-cuttings and plant-chimæras in Pelargonium. Plants raised from buds formed on roots may differ from those

raised from shoots, demonstrating the existence of an inner component. The plant may be (1) male only, (2) female only, (3) sterile, whereas the inner component is in each a normal hermaphrodite. The distinction is probably in epidermis alone. Zonal Pelargoniums raised by cross-fertilisation between green and albino tissues show the artificial formation of chimæras. Rothamsted Experimental Station had an exhibit illustrating the inoculation of lucerne with nitrogen-fixing bacteria (Mr. H. G. Thornton and Prof. N. Gangulee). A motile stage has been discovered in the life-cycle of *Bacillus radicicola*, the organism forming nodules on the roots of leguminous plants within which nitrogen is collected and utilised by the plant. This stage is connected with the spread of the bacteria through soil. The results have been applied, with some success, to the practical problem of inoculating the lucerne crop. The National Physical Laboratory showed a Guild colorimeter for fundamental investigations in colour vision (Mr. T. Smith). Light from a single source, after passing through gelatine filters of three selected colours arranged symmetrically about the circumference of a circle, is brought to a common axis by a rotating prism. The mixture thus obtained is presented side by side with the colour to be measured by means of a photometric cube.

AT the Conference of Women in Science, Industry and Commerce, held at the British Empire Exhibition on July 15-18, Miss C. U. Kerr read a paper on the effect of welfare work upon health and efficiency. Miss Kerr outlined the history of the welfare movement and pointed out that the earliest experiments in welfare work were initiated in engineering factories. The chief branches of welfare were considered and a special plea put forward for the adequate provision of food for the workers. Many firms are still without canteens, and those which do have them often fail to see that the food is interesting and appetising. The proper selection of workers was discussed and an interesting suggestion made that many operations could be well performed by people not of robust physique, provided that the conditions were good. The advantage to a delicate person who finds his job I knows he can do it well cannot be calculated only by his efficiency at work; the mental effect is probably the cause of the improvement related by the writer in connexion with a tobacco factory. One would like to see the engineering metaphor disappear from these discussions. The writer of this paper quotes the phrase "Human Engineering" as an apt description of welfare work and calls "food for the producers," "fuel for the human machines." These phrases stand for a mechanical interpretation of life which has been, and still is, the cause of no little trouble in the industrial world. A machine is a means to an end: Can that be true of a human being?

MR. GOYDER, of Mill Hill School, has maintained two-way radio communication with the leader of the MacMillan Expedition in the Arctic. When communication was first established on July 18, the *Bowdoin*, with Captain MacMillan on board, was at Hopedale, Labrador, but on July 24 she was crossing the Arctic Circle. The two ships, the *Peary* and the *Bowdoin*, are proceeding to their base at Etah in Greenland, and it is hoped to make an aeroplane base at Cape Thomas Hubbard in Axel Heiberg Land. Mr. Goyder works with a 250-watt Mullard valve on a wave-length of 40 metres. He only uses a single wire Hertz aerial, but he receives on a special circuit devised by Mr. Remartz, who operates the radio apparatus on the *Bowdoin*. The messages are received best between midnight and six o'clock in the morning. Mr. Goyder has himself transmitted to America several messages from the explorers to their friends. It will be remembered that he was the first to maintain two-way communication between Great Britain and New Zealand. Mr. Goyder is to be congratulated on his success, which will raise the status of British amateur radio-telegraphy.

AT the annual general meeting of the Marconi International Marine Communication Co., Ltd., held on July 24, Senator Marconi gave an interesting sketch of the lines on which radio signalling is developing on board ship. During the past two years, numerous experiments have been made to find out how far radio telephony is desirable and practicable in the mercantile marine. Trials were made in trawlers as well as in liners, both between ships and between ships and shore. The results obtained prove that there is no technical difficulty in the way of accomplishing a satisfactory service of duplex radio telephony between ship and ship when they are on the high seas and away from the areas of congested radio-telegraphic traffic. In one instance a range of nearly 400 miles was covered. If a demand arises by ship's commanders and passengers, it can easily be met. There is, however, no likelihood at present of radio telegraphy at sea being superseded by radio telephony. When financial matters are less stringent, it is probable that shipowners with the collaboration of the Post Office will give facilities for conversation between passengers and shore stations. The Board of Trade has recently made a regulation under which the use of a radio automatic calling device is made compulsory for all ocean-going vessels the crews of which number less than 50. Shipowners, however, are appealing against this regulation as they consider that the present time is inopportune for increasing their financial burdens. Senator Marconi said that there has been a rapid increase in the demand for his company's direction finder, which has proved of great value to navigation, especially in foggy and rainy weather. A ship fitted with this device is able to assist other ships in its neighbourhood by sending them their positions.

SINCE the War, France has paid particular attention to securing its economic independence of other nations. Great attention has therefore been paid to developing "la houille blanche," or water power, so called to distinguish it from "la houille noire," or

coal, from which thermal power is developed. As the total possible power output of the mountain torrents of the Pyrenees and the Alps and of the Rhone, the Garonne, and the Rhine is several times greater than the power equivalent of the present French output of coal, there is plenty of scope for industrial development. In connexion with the present exhibition of "La Houille Blanche" at Grenoble (May–November) the *Revue Scientifique* has published an excellent historical and industrial account of the state of the art of hydro-electrics. It is interesting to remember that Fourneyron in 1837 installed at Saint-Blasien in the Black Forest small water turbines 31 cm. in diameter, producing 60 horse power, the fall being 114 metres. The efficiency of the machines was no less than 80 per cent., which is quite comparable with that of the best modern machines. In the historical survey an account is given of the work in hydrodynamics done by Pascal, D'Alembert, Lagrange, Laplace, Poisson, Cauchy, and others down to Poncelet and Girard. Interesting portraits are given of the French scientific workers. In the technological section illustrations are given of the chief steam and water-power stations in France, and methods are indicated for accelerating the development of industry by distributing electric power over wide areas. H. Parodi, the engineer to the Compagnie d'Orléans, contributes a thoughtful paper on the different policies adopted by the various countries of the world with regard to railways operated by electric traction, and more particularly those which utilise water power through the medium of electricity. The curves he gives indicate clearly when electric traction becomes a commercial proposition.

THE River Pollution Committee of the Ministry of Agriculture and Fisheries, having learned that the impression prevails in many quarters that the Committee is antagonistic to the use of tar in the preparation of road surfaces, is anxious to correct this impression. The Committee is concerned solely with the question of river pollution from the point of view of the fishery interest. The constituents of tar, if they find access to a river, are most injurious to fish and their food, and the Committee earnestly advocates the avoidance of the use on any road, the washings from which are likely to find their way directly into a stream, of any road dressing containing tar or tar products. Washings from bituminous surfaces are, however, innocuous to fish and their food, and the Committee has advocated the use on roads in proximity to streams of bituminous dressings. Obviously, the roads with which the Committee is concerned constitute only a small fraction of the total roads of the country. The Committee's policy has been solely to urge upon all road authorities that care should be taken to avoid the use of tar at what are the danger points from the point of view of pollution. The Committee has examined a number of preparations for road-surfacing, and is prepared, if consulted by road authorities or other persons concerned, to advise them as to the suitability for use in proximity to streams of such preparations as they have examined.

HEATHFIELD HALL, Watt's residence at Birmingham, where he lived from 1769 until his death, is now in course of being demolished to make way for new buildings which are to be erected on what was once his estate. Fortunately, however, all the machines, tools, benches, etc., from Watt's workshop have been presented by Major Gibson Watt to the Science Museum at South Kensington, where on the ground floor of the new building, not far from three of the engines which were built by the firm of Boulton and Watt between 1777 and 1797, an accurate reproduction of James Watt's workshop has just been completed. The present owners have generously presented the door, windows, flooring, etc., of the old room, so that it has been possible to produce a replica of the old attic, and in it to arrange the contents as they were at the time of Watt's death. The two copying sculpture machines, the lathe, and benches, boxes of tools, tables, etc., take up too much space for the public to circulate in the room, but a large plate glass window in one of the walls allows the workshop and its contents to be seen readily.

THE following officers of the Institution of Electrical Engineers have been elected:—*President*, Mr. R. A. Chattock; *Vice-Presidents*, Lieut.-Col. K. Edgcumbe, Prof. W. M. Thornton; *Hon. Treasurer*, Mr. P. D. Tuckett.

AT the annual general meeting of the Royal Society of New South Wales, held on May 6, the following officers were elected:—*President*, Prof. R. D. Watt; *Vice-Presidents*, Mr. J. Nangle, Mr. E. C. Andrews, Mr. C. A. Sussmilch, and Dr. C. Anderson; *Hon. Treasurer*, Prof. H. G. Chapman; *Hon. Secretaries*, Mr. R. H. Cambage and Dr. R. Greig-Smith.

SIR ERNEST and LADY RUTHERFORD left Great Britain for Australia and New Zealand on July 25, on the s.s. *Ascanius*, bound for Adelaide. While their main object is to visit their parents and relatives in New Zealand, Sir Ernest has also promised to deliver lectures on aspects of modern physics in some of the chief cities of Australia and New Zealand. They hope to return to England in January 1926.

AT the annual meeting of the Museums Association held at Exeter on July 7, the following resolution was passed:—"That the Museums Association desires to place on record its opinion that the present reckless destruction of animal and plant life by collectors and others will, if continued, result in a deplorable loss to posterity." Mr. J. Bailey, late of the Circulating Department of the Victoria and Albert Museum, London, was elected president of the Association for the year 1925–26. The next conference will be held at Bournemouth in July 1926.

PROF. A. A. MICHELSON, professor of physics in the University of Chicago, has been appointed to the first of the distinguished service professorships which have been established in that University. These professorships form part of a development scheme which, we learn from *Science*, has been instituted with the view of raising a new endowment fund of 6,000,000 dollars. Special efforts were made to obtain funds

in sums of 200,000 dollars, the incomes from which would be devoted to professorships such as that now conferred on Prof. Michelson. The present professorship is due to the generosity of Mr. M. A. Ryerson, of Chicago, formerly president of the board of trustees and donor of the Ryerson Physical Laboratory of the University.

THE autumn meeting of the Institute of Metals is to be held at Glasgow on September 1-4, under the presidency of Prof. T. Turner, Feeney professor of metallurgy in the University of Birmingham. The proceedings commence with the fourth autumn lecture, by Sir John Dewrance, who will take as his subject "Education, Research and Standardisation." Sixteen papers on various aspects of the constitution and properties of metals and alloys are to be submitted for discussion at the meeting. The lighter side of the programme announces visits to works and places of interest in the neighbourhood of Glasgow, and special arrangements are being made for the entertainment of the ladies present. Railway vouchers enabling members of the Institute and their friends to purchase return railway tickets to Glasgow at the rate of a single fare and a third can be obtained from the secretary of the Institute of Metals, 36 Victoria Street, London, S.W.1.

THE Council of the Institution of Electrical Engineers, which took an important part in founding the Society of Radiographers in the year 1920, and, under that Society's constitution, has up to now nominated six out of the eighteen members of the Society's Council, has withdrawn its nominees and terminated the Institution's connexion with the Society. This action has been taken because the majority of the Council of the Society of Radiographers has resolved upon certain alterations of the Society's articles, with which the Council of the Institution of Electrical Engineers is in entire disagreement, as in the Council's opinion these alterations will materially lower the professional status of non-medically qualified radiographers.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: An advisory agricultural economist at the Seale-Hayne Agricultural College, Newton Abbot. The Secretary and Bursar (August 4). A second assistant in botany in the University of Aberdeen. The Secretary (August 10). An assistant lecturer in physics at the University College of Wales, Aberystwyth.—The Secretary (August 30). A laboratory assistant for the Veterinary Research Department of the Government of Uganda.—The Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1, quoting M13 800.

Our Astronomical Column.

THE JULIAN DAY.—A matter that excited much interest was settled by the International Astronomical Union, after a long discussion, by a considerable majority. When it was decided that the astronomical day should begin at midnight, instead of noon, a diversity of view was manifested as to whether the Julian day should follow suit, or begin at noon, as heretofore. Speaking broadly, the former view was held in America, the latter in Europe. The matter is of especial importance for variable-star observers, since it has for long been the custom to use the Julian day both for the elements of these and for recording observations.

It was further pointed out that the whole point of the institution of the Julian day system was to have a method of recording time that should be independent of all changes of style or calendar changes, and that once established such a system should not be lightly broken. It was, indeed, admitted that there had been a change of two hours since its institution; its beginning was then noon at Alexandria, afterwards altered to Greenwich noon. However, a change of two hours applied to comparatively rough early observations is of little moment compared with a change of twelve hours in accurate modern observations. Many of the Americans, including Prof. Shapley, admitted the force of these arguments, and supported the retention of the noon beginning, which was afterwards confirmed by the Union as a whole.

An endeavour was also made to agree on a name for the new astronomical day that begins at Greenwich midnight. A very large section expressed disapproval of continuing to use the phrase Greenwich Mean Time for the new system, but no alternative was found that commanded general assent; it was agreed to leave the matter open, as being comparatively unimportant, provided one made clear what time-system one was using. The title "Universal Time" met with most support, and the Astronomer-Royal said he would endeavour to get this name inserted in the Nautical Almanac as a second title, Greenwich Mean Time continuing to be the first title.

PERTURBATIONS OF MINOR PLANET 944, HIDALGO.—Discovered by Dr. Baade of Bergedorf in 1920, Hidalgo is one of the most interesting of the minor planets, being near the orbit of Mars when in perihelion, and near that of Saturn when in aphelion. Its period, 13¾ years, does not differ greatly from that of Jupiter, its orbit is inclined to the ecliptic at the high angle of 43°, the greatest of any minor planet. However, its passage of the descending node takes place not more than half a unit from Jupiter's orbit, and the question of the perturbations by the latter is of interest. Mr. K. Jantzen investigates the secular perturbations by Jupiter in Bulletin of Vilno Observatory, No. 5, using the method given by Hills in vol. 1 of the Amer. Ephem. Papers. The circle of eccentric anomaly was divided into 192 parts, this large number being necessary owing to the near approach to Jupiter's orbit, which occurs when E = 85°.

The final values of the secular perturbations of the elements are, $e + 14''\cdot4$, $i - 16''\cdot2$, $\Omega - 26''\cdot5$, $\pi - 65''\cdot3$, $L + 57''\cdot6$. The method of special perturbations would have to be used at the time of a near approach of the two bodies; there was actually a fairly near approach (less than an astronomical unit) in 1922. This was probably the closest in the last century or thereabouts.

Some authorities are inclined to rank this body as a comet rather than a planet. It seems, however, better to limit the term comet to bodies showing nebulosity. Hidalgo always appeared stellar.

Research Items.

THE "LOST CITY OF NEVADA."—Dr. M. R. Harrington, of the Museum of the American Indian, Heye Foundation, contributes to the *Scientific American* for July an account of the excavation of the Pueblo Grande de Nevada, also known as the "Lost City," which began in November last. This settlement is probably one of the oldest in North America, north of Mexico, antedating the cliff dwellings of New Mexico and Arizona. It lies scattered along the banks of the Muddy River over a distance of five or six miles, with a greatest breadth of a mile. About thirty houses have been uncovered. On the floors and in graves have been found implements of bone and stone, pottery and ornaments of shell and turquoise. The inhabitants gathered wild natural products, but also farmed, raising corn, beans and squashes. They had no domesticated animals except the dog, and hunted deer, mountain sheep, and the jack rabbit, though the bones of game animals are not numerous. Considerable progress had been made in weaving and dyeing. The pottery has a general resemblance to Pueblo but belongs to an early period, while the dwellings are of the primitive type, consisting of an oval pit two or three feet deep, which must have had a superstructure of poles and matting. The development in type of the dwelling shows that Pueblo Grande belongs to the close of the pre-Pueblo and the beginning of the Pueblo period.

DECORATIVE DESIGNS ON CARVED WOODEN FOOD-BOWLS, PORTUGUESE EAST AFRICA.—Some interesting notes on the origin of the decorations on carved wooden food-bowls among the Va-Lenge and Va-Chopi of Portuguese East Africa are contributed by Miss E. Dora Eady to Vol. 11, Part 2, of the Annals of the Transvaal Museum. Both peoples have an elaborate system of hair-dressing, varying with the great social events and crises of their life. The food-bowls, generally circular in shape, when turned upside down are regarded as human heads, and the little plaitings of the hair which are grouped together in a triangular shape are reproduced on them as incised triangles. A notched arrangement, forming a series of lozenges at the base of each triangle, is also copied from the hair, though on the bowls the place of the lozenge is sometimes taken by a chevron. The absence of the chevron or lozenge on the bowl pattern represents the hair of widows and uninitiated girls. If the lozenge is very small it indicates an initiated girl or one ready for marriage. The chevron means that the woman's husband is ill, some think recently deceased. A hair-parting encircling the head is also reproduced on the bowl, where by some it is said to represent the line of scalping or decapitation followed formerly when the Va-Chopi were head-hunters.

AMERICAN OAKS.—The twentieth volume of the Memoirs of the National Academy of Sciences (U.S.A.) is devoted to a monograph by Dr. Wm. Trelease of the oaks inhabiting the New World. Although the oaks of the United States and Canada have been reviewed from time to time by Sargent and other American botanists, no such comprehensive work as this, which deals with the genus Quercus as represented on the entire continent, has appeared before. The region occupied by the American oaks extends from Canada southwards to the Columbian Andes and Cuba, the greatest aggregation of types occurring in the highlands of Mexico. Dr. Trelease divides them into three main sections, namely, the white oaks (Leucobalanus), the red oaks (Erythrobalanus), and a small intermediate oak (Protobalanus). These sections are subdivided into numerous groups, for each of which a detailed general description is provided, the individual species being differentiated by one or more leading characters only; but new species, of which the author has made a considerable number, are described in full. The geographical range of each group and species is defined, and an adequate, though not necessarily complete, synonymy is given. The real value of such a work as this can only be appreciated of course by long and continued use, but there can be no doubt that it has simplified for the student the very intricate and difficult problem of the American oaks, and brought into convenient compass a vast amount of exact information concerning them. The introductory essay, dealing with the history of the genus, details of structure in stem, leaf, flower, and fruit, taxonomy, geographical distribution, hybridity, and the fossil botany of oaks, is admirably written. For the purpose of preparing this monograph, which is illustrated by 420 plates, the author has studied the material in all the great herbaria of the world.

LEAF SHAPE.—The factors controlling leaf shape are undoubtedly various and differ under different conditions, but Dr. W. H. Pearsall and Miss Alice M. Hanby seem to throw some light upon them in the experimental study of *Potamogeton perfoliatus*, which they report upon in the *New Phytologist*, vol. 24, No. 2. Using Pond's method of enclosing the root system in one culture solution and the submerged shoot system in another, they are able to analyse the effect of different solutions upon growth. Their results make clear the great importance of the ratio of calcium to potassium and sodium ions in the solution upon the relative length and breadth of the leaf, whilst their analysis of this difference shows it must be attributed to a different activity of the meristem when growing in solutions which vary in the relative proportions of these ions. Their conclusion is that with this variable species, changes in leaf form are usually determined under natural conditions by the calcium content of the soil and to a less extent by light.

ON AMMONITES VIA NAUTILUS.—A paper by Martin Schmidt entitled "Ammonitenstudien" (*Fortschr. Geol. und Paläontol.*, Hft. 10) covers a far wider field than its title would indicate. The first portion, illustrated by an excellent plate, treats of new and little-known Ammonites from the Schwabian Lower Lias. The second portion contains a general summary of what is known concerning Nautilus, including a histological section by Max Rauther, followed by an attempt to apply that knowledge to the study of the Ammonites. The author favours the idea that the Ammonites were plankton feeders and their successive modifications and destruction were entailed by the altered habits and extinction of their food.

PALÆONTOLOGICAL HISTOLOGY. — The Nigerian Government has published (Geological Survey of Nigeria, Occasional Paper No. 2) an account by Baron Nopcsa of some fragments of fossil reptiles from Sokoto. These are for the most part Crocodilian or Deinosaurian, but are too fragmentary to yield much information beyond the suggestion that the beds in which they occur are Lower Eocene in age. The chief interest in the paper lies in the application of histological methods to palæontology, whereby it seems possible from the structure of the Haversian canals to distinguish Crocodilia from Deinosauria.

Further investigation along these lines should lead to interesting results.

ARCHÆOPTERYX.—Dr. Petronievics has continued his investigations on the genus Archæopteryx, which he began upon the specimen in the British Museum, by a study of the example in Berlin. From a comparison of the two he comes to the conclusion that, so far from being the same species, they represent two different sub-classes of birds. For the British Museum specimen he retains the name Archæopteryx, and calls the Berlin one Archæornis. The first is considered to be a primitive ratite and the second a primitive carinate. In general Archæopteryx shows the more primitive characters of the two. The author comes to conclusions, which are certainly not those of the text-book, that the ancestor of birds is to be sought in a primitive group of the Lacertilia and that the resemblances which have led investigators to see some affinity between birds and the Deinosaurs are to be interpreted as due to convergence. The paper is published in the *Annales Géologiques de la Péninsule Balkanique*, vol. 8, 1925.

THE MINERAL IDDINGSITE.—The red-brown alteration product of olivine known as iddingsite has become very familiar to petrologists during the last thirty years, but hitherto its nature and properties have been only vaguely realised. C. S. Ross and E. V. Shannon have now presented a careful study of the material in the Proc. U.S. Nat. Museum, vol. 67, No. 2579, 1925. They conclude that iddingsite is not a product of weathering, but is the result of metasomatic processes associated with the later stages of a cooling magma. It forms from olivine soon after the close of crystallisation under conditions of oxidation and hydration: MgO is abstracted, FeO is oxidised to Fe_2O_3 and water is added; and the resulting product has a formula of the type $MgO . Fe_2O_3 . 3SiO_2 . 4H_2O$. The optical properties are distinct and different from those of any other described mineral, including serpentine, which differs in mode of origin, chemical composition, and physical properties. Iddingsite is therefore regarded as a definite mineral species.

THE GEOLOGY OF NORTH LONDON.—Under this title the Geological Survey of Great Britain issues an explanation of one-inch Sheet 256 England, by C. E. N. Bromehead, with contributions by H. G. Dines and J. Pringle. The area comprised includes London north of the Thames, and the surrounding country as far north as Watford and Enfield. The whole ground has now been surveyed on the six-inch scale, but a large proportion of the area has been built over and more is still "under development," so that there are few open sections available for study. Save for brief allusion to the older rocks the formations dealt with range from the Upper Chalk to the Alluvial. Despite the evidence of palæontology, the Glacial deposits are still placed at the beginning instead of the close of the Pleistocene period, and though many of the Pleistocene mammalia are duly chronicled, we miss all reference to *Rhinoceros tichorhinus*, a fine skull of which, now in the British Museum (Natural History), was found at Perivale in the Brent valley, and recorded so far back as 1913.

PERIODIC CHEMICAL CHANGES.—A further paper on periodic chemical phenomena by E. S. Hedges and J. E. Myers appears in the Journal of the Chemical Society for May. Typical periodic reactions have now been investigated from an electrochemical point of view. In the case of activated metallic couples dissolving in hydrochloric acid or ammonium chloride, the potential difference between the couple as a whole and the solution, and that between the two components of the couple, undergo periodic fluctuations which synchronise with the periodic evolution of gas. A potential difference exists between the active and inactive forms of a metal. The periodic deposition and dissolution of iron on magnesium in an acid solution is investigated, together with a few other similar cases. A corresponding oscillation of the electropotential occurs, and often there is a periodic evolution of hydrogen. Examples are given of "autoperiodic" reactions, where one electrode serves both as the reacting metal and as the activating agent. The results are correlated with those of previously published investigations.

A VACUUM THERMO-ELEMENT. A number of instruments have recently been described for spectroscopic observations, and for the direct measurement of the radiation of the stars, in which a thermo-element, consisting of two thin wires of different metals soldered together with a small receiving plate attached to the junction, is mounted in a vacuum. Messrs. W. J. H. Moll and H. C. Burger criticise this arrangement in the *Zeitschrift für Physik* of June 5, pointing out that it is slow in action, owing to the mass of solder necessarily added at the junction. They describe a method in which the edges of two plates of constantan and manganin a few millimetres thick are soldered together with silver, and then rolled out in the direction of the soldered junction to about 1 μ thickness. The result is a long thin ribbon of foil, one-half of constantan and the other of manganin, soldered together along the length of the ribbon by a thin line of silver. Narrow strips at right angles to the length can be cut from this, and it is even possible by etching to obtain a small receiving disc about the junction, with narrow strips of foil on either side, which can be soldered to the supporting wires. Such an element can be mounted in an evacuated bulb of glass or quartz, which can be sealed off permanently; and when this is enclosed in a double copper vessel with small windows, it makes a very sensitive and rapidly adjusted instrument.

STANDARDISATION OF SIEVES.—In an article in the June issue of *State Technology*, Mr. P. E. Masters directs attention to a difficulty under which British manufacturers who require to sift fine material labour, owing to the absence of any satisfactory standard to which sieve makers can work. A sieve of 80 meshes to the linear inch may be made of wire of gauge from 38 to 42 according to the will of the maker, and the user of the sieve only discovers a change of gauge by some serious modification of the properties of the sifted material. The proposals of the Institution of Mining and Metallurgy for standard sieves involve the use of wires not of standard gauges, and the sieves are so difficult to manufacture that high prices are quoted for them. The author proposes that the standard relation between the diameter d of the wire and the distance D of the centre lines of consecutive wires apart shall be $D = 2.7d$. This gives as the proper wires for 10, 20, 30 and 40 meshes to the inch, gauges 19, 25, 29 and 33 respectively, for 60, 80, 100, 120, 140 and 160 meshes, gauges 37, 40, 42, 44, 45 and 46 respectively, and for 200 meshes, gauge 47 wire.

ERRATUM.—In NATURE for July 11, p. 61, col. 1, paragraph 2, line 13, the words "It is also a genus long known only from Europe" should refer to Balanocrinus.

The International Astronomical Union at Cambridge.

WELCOMED by Lord Balfour, Chancellor of the University of Cambridge, who dwelt on the value of international co-operation, by Dr. J. H. Jeans, president of the Royal Astronomical Society, who dwelt on the revolutions that astronomy has compelled in human thought, and by the Astronomer-Royal, who gave a short account of the manifold activities of the Union since its birth in 1919, the conference made a happy and successful start on July 14 in the Senate House of the University. In his address at the opening meeting of the general assembly of the Union, at which there were present more than 200 national delegates, members of the Union and invited visitors, the president, Prof. W. W. Campbell, reminded the Union that it is charged with the care of international co-operation in astronomy wherever it is necessary or useful. The principal fields of astronomical activity are represented by more than a score of committees; their reports refer to great pieces of work in which there are many students, where co-operation is required to secure a fairly homogeneous system over the entire field. He illustrated the point by a short historical account of the study of the variation in latitude. We have now a very good knowledge of the conditions that are requisite for success in astronomical co-operation, and in launching fresh schemes, as the Union must do from time to time, we must beware of starting on new and untried work with too ambitious a programme. Prof. Campbell added a strong and evidently welcome tribute to the work that the general secretary of the Union, Prof. A. Fowler, has done for it since its foundation.

Dr. G. Abetti, Dr. H. Chrétien, Lieut.-Col. F. Stratton, and Dr. F. Henroteau were appointed recorders for the meeting, and Dr. A. Wolfer was appointed vice-president for the meeting in the absence of Prof. K. Hirayama.

It was announced that Norway, Spain, Portugal and Switzerland are now full members of the Union, and the adherence of Sweden has been officially notified. There are now 22 countries in the Union, and 20 of these were actually represented at the conference. After considerable discussion, resolutions submitted by constituent bodies of the Union were submitted to committees, save one from the United States. This was a proposal that the Committee on Selected Areas should be invited to reorganise itself under the auspices of the Union. The motion was deferred until such time as Germany becomes an adhering country of the Union, a necessary condition which the American committee had hoped to see fulfilled at the Cambridge meeting.

The Union then dissolved itself into 27 committees, which for the next four days dealt faithfully each with its appropriate portion of the 122 pages of the report prepared by Prof. Fowler. It is impossible here to do more than mention very briefly some of the more important resolutions of wide interest which were ultimately adopted by the General Assembly of the Union.

The committee on standard notations appointed a sub-committee to report to the Union at a later date on a revision of the boundaries of the northern constellations. Different systems adopted by earlier writers have led to an annoying confusion in the double names allotted to stars near the boundaries of constellations.

It was agreed that for all telegrams transmitted from the Bureau at Copenhagen, mean places should be adopted, referred to the equinox at the beginning of the year. Where desired, adequate descriptions of newly discovered objects should be given.

A grant of 250*l.* a year for three years was made to Prof. De Sitter to carry out a programme of observations of azimuth at an equatorial station and at northern and southern stations, for the determination of fundamental declinations; the instrument and the observer are to be found by the Leyden Observatory. A revised list of stars to form, or to be developed into, a *fundamental* list was also adopted and recommended for as continuous observation as possible. The further study of the variations of refraction at different hours of the day and in different parts of the sky was also recommended. It was announced that Greenwich, the Cape and the Naval Observatory at Washington are to co-operate with the German astronomers in the observation of reference stars in connexion with the coming opposition of Eros in the year 1930–31.

With regard to solar physics, it was agreed to arrange that additional observations of the sun as nearly continuous as possible should be made at or about the time when magnetic storms are in progress or expected. There would have to be organised some service to supply the necessary information to the co operating observatories. The view was expressed by M. Deslandres and adopted by the Union that it is important for the variation of the solar constant, announced by Dr. Abbot, to be studied in other countries, especially in reference to accompanying changes in meteorological elements. Strong support was given to the suggestion that a Solar Physics Observatory should be established in Japan. With regard to apparent changes in solar rotation, Dr. St. John announced that the Snow telescope as used by Adams would be reconstituted to compare its results with those given by the 150-foot tower telescope.

Several important resolutions were adopted as to standard wave-lengths. Of these the most important was the following:

The primary standard of wave-length, λ6438.4696 of cadmium, shall be produced by high voltage electric current in a vacuum tube having internal electrodes. The lamp shall be maintained at a temperature not higher than 320° C., and shall have a volume not less than 25 cubic centimetres. The effective value of the exciting current shall not exceed 0·05 ampere. At room temperature the tube shall be non-luminous when connected to the usual high voltage circuit. So long as the lamp used is capable of giving well defined interference fringes with retardations of at least 200,000 wave-lengths, it is not, however, necessary to specify the volume of the tube serving as lamp. The primary standard should always be produced in a lamp which is ascertained to give retardations of at least 200,000 wave-lengths.

General Ferrié announced that the world scheme for the wireless determination of longitudes as approved at Rome has been worked out in further detail; experiments of considerable interest with diverse optical instruments have been carried out at Paris to check the conflicting views as to the relative success of small field instruments and large observatory transit circles. A number of resolutions as to the details of the scheme were adopted. Some preliminary experiments are to be carried out during the two months commencing October 1, 1926.

A strong wish was expressed by the Union that the U.S. Coast and Geodetic Survey should re-establish the latitude station at Gaithersburg so as to renew its co-operation in the study of the variation of latitude. The help of meridian observers in securing fresh

determinations of the declinations of the stars involved in this work was also strongly urged.

A research survey for all the minor planets, giving a record of available fundamental investigations on the perturbations of minor planets, was approved by the Union on the suggestion of Prof. Leuschner.

Observatories with suitable instruments were asked to arrange to secure annually photographs of the meteors of the three annual showers, the Perseids, Orionids and Geminids.

Welcome news was given by Prof. Turner as to the progress of the *Carte du Ciel*. France and Italy hope to complete their zones in eight years' time or sooner. The chief delays are at Tacubaya and Sydney, and the Union appealed to the two governments concerned for more rapid prosecution of the work.

In parallax work it was recommended that observers of trigonometric parallaxes should shape their programme, so far as possible, to meet the needs for spectroscopic and dynamical determinations. Faint stars of large proper motion are especially important. It was also agreed that photometric observers should be urged to determine carefully the magnitudes and colour equivalents of these stars.

Prof. von Zeipel reported through the Committee on Photometry that at Upsala it is proposed to determine the photographic and photovisual magnitudes of the 11,700 stars in the A.G. catalogue between ·35° and ·40°.

A grant of 6000 francs was made to Dr. Aitken at the Lick Observatory for the clerical work of the Double Star Bureau, in connexion with the extension of Burnham's General Catalogue. The use of the reversing prism in determining position angle in double stars was also approved.

During the meeting co-operative work on the important Cepheid variables was arranged. As to notation, the Union supported that of Chambers, André—Nijland. A list of variable stars needing special attention, drawn up by Prof. Nijland, was published in the report of the Committee on Variable Stars.

It was agreed that a new catalogue of the brighter and larger nebulæ should be drawn up, illustrated by plates and including globular clusters. The system to be adopted for classification is to be purely descriptive. It was also recommended that in published work on nebulæ the N.G.C. or I.C. number should always be used, and that steps be taken to divide the sky into zones allotted to different observatories for work on agreed lines on nebulæ. It was also agreed that observatories should be encouraged to publish, whenever possible, copies of their best spectrograms. This would be of assistance for the next stage in stellar spectral classification. A small catalogue of some 20 to 25 stars is to be prepared to serve as standards in radial velocity work.

Important resolutions were adopted amending the forms, times and modes of emission of radio time signals. For the international time system at certain times it was agreed to replace the present three dashes by six dots.

The above brief summary of the more interesting resolutions indicates that a large volume of work was got through in the various committees. In addition, much valuable material is incorporated in many of the reports of the committees, especially in the accounts of recent work. It is to be hoped that the volume of proceedings may shortly be available to the public. The reports of the committees were for the most part taken without discussion at the general assembly in its closing meetings, the one fight being over the question of the hour of commencement of the Julian day. By a large majority it was agreed that this should remain at noon. The failure of the International Research Council at its recent meeting at Brussels to make any change in the statutes governing the conditions of national adherence led to a number of statements being made by the various national delegations. The United States, Italy, Japan, Spain, Denmark, Sweden, and Canada urged that all restrictions should be removed, while Belgium, France, Poland, Czecho-Slovakia, Portugal, and Rumania contented themselves with asking the International Research Council not to block the admission of the Central Powers when they became members of the League of Nations.

The next meeting of the Union was arranged, on the invitation of the Dutch government, to take place in Holland in 1928. The committees of the Union were appointed for the next three years, including new committees on stellar statistics and on solar parallax. Officers of the Union for the next three years were elected as follows:—Prof. De Sitter (president); Profs. Cerulli, Deslandres, Hiravama, Eddington, and Schlesinger (vice-presidents); Lieut.-Col. Stratton (general secretary).

A very successful meeting closed on July 22. Generous hospitality was shown throughout by the Colleges. Amongst many interesting points referred to in the side meetings was an announcement that Prof. Adams has measured the Einstein shift in the spectrum of the companion to Sirius. The result is consistent with the theoretical view already announced, that this star, though 2000 times as dense as platinum, obeys the gas laws.

The Field Museum of Natural History, Chicago.

THOSE connected with museums in Great Britain generally read the annual reports of museums in the United States with some envy. This is partly because those reports are produced in a style to interest the reader and to do credit to their institutions, partly because of the vigorous work they reveal. The chief factors, no doubt, are brains and enthusiasm, but these cannot operate without the other factor—sufficient funds. The report of the Field Museum of Natural History, Chicago, for 1924, which is just to hand, illustrates these points. It consists of 115 pages, of which half give a readable account of progress, and it is illustrated by 16 photogravure plates prepared in the Museum, as are all the Museum publications. That is how it is possible for the volume to bear the date January 1925.

The Field Museum corresponds to our own Natural History Museum plus a department of anthropology. Its scientific staff, exclusive of the Director, numbers only twenty, but its expenditure last year was about 117,370*l*. The expenditure of our Natural History Museum for last year was about 97,925*l*., and the scientific staff numbers forty-three permanent and thirteen temporary members.

The extension work of the Field Museum in public schools, the reproduction of living plants in models, and the pensions to employees are provided for by separate funds. Setting those activities aside, one notes that about 5000*l*. was spent during the year on expeditions; then there are three guide-lecturers, who, besides conducting visitors, give regular lectures illustrated by lantern and cinematograph; the printing has already been mentioned, but it should be added that this includes a large number of coloured posters

and advertisement folders. Such are a few of the lines of work in which British museums of similar size and character cannot compete. This expenditure, however, cannot be regarded as wholly unproductive, for it must certainly attract a large number of subscribing members. In Great Britain most museums are maintained by compulsory imposts, and free gifts of money are harder to come by. Whatever may be the relative advantages or disadvantages, it is certainly creditable to the citizens of the United States that they support so many admirable museums by private generosity.

From the body of the report a few items may be selected as continuing the contrast. Leakage through the roof of the top-lighted halls has been remedied in drastic fashion by coating the 38,500 square feet of skylights with a double thickness of Celotex overlaid with Ruberoid roofing. This has involved a change in the lighting of the halls from daylight to electric light. Making a virtue of necessity, it is claimed that artificial lighting is more suitable for the exhibited material because the illumination is more uniform and avoids the fading effects of sunlight. Since many American museums have long surpassed those in Britain in the use of electric light, we may be sure that some of the "dazzle headlight" effect recently introduced into one of our largest metropolitan museums has been avoided; but we are not so sure about the fading.

A somewhat full account is given of the re-erection of two Mastaba tombs from Egypt. The blocks arrived in 206 cases weighing 96 tons. The lower courses and missing stones have been replaced by cement blocks. The stones are bedded in lead, joined by dowels and metal clamps, and each secured to a bracketed upright steel channel. The ceiling has been raised 18 in. above the walls, and hidden lights are in a trough on the top of the wall. Every care has been taken to prevent humidity, and the room at the back of the tombs is mechanically ventilated. These and other details are given in the report "in the hope that the information may prove useful to other institutions." The use of terms unfamiliar, at least in Great Britain, and the absence of illustrations will, it is to be feared, frustrate this hope.

A poisoning and storage room, apparently in five sections, for the preservation of perishable material, has been constructed of compressed steel and equipped with storage bins of cedar wood. Formaldehyde candles have been used for poisoning with good success.

Many British provincial museums have long experienced the popularity of a wild flower exhibit, but none of them has attempted to show living and growing wild plants on anything like the scale attempted last year in the Field Museum. The case was a kind of large flower-box, and soon proved so successful that it was replaced by one four times the size, permitting of an approximately ecological grouping, which ranged from sand-dune plants to water plants. During the season about 500 species were shown, with full labels and guide leaflets.

Though not of such interest to the public, the numerous paragraphs revealing what careful attention is paid to storage, unpacking, sorting, and general office equipment will be read with appreciation by all museum curators. Nothing is more difficult to impress upon governors, committees, architects, and providers of funds than the fact that the life of a museum is in its workrooms and workshops, and that in any plans for development the first attention should always be paid to those unseen but indispensable offices. What is a banqueting hall without its kitchen? We can better dispense with the toastmaster than with the cook. F. A. BATHER.

The Sixth International Conference of Pure and Applied Chemistry.

SOME seventy foreign delegates, representing twenty different countries, attended the conference which was held recently in Bucharest. The decoration of railway stations and of public buildings and the more than generous hospitality provided by private individuals, public officials and organisations throughout the duration of the conference, indicated how important the event was considered in Roumania, and demonstrated the sympathetic attitude of its people towards chemistry.

The actual business of the conference was transacted on June 22 - June 25 under the presidency of Sir William Pope, and the other British delegates were Prof. J. C. Drummond and Prof. C. S. Gibson. The prestige of British chemistry can scarcely be said to have been adequately maintained since Denmark, the United States, Spain, France and Italy were each represented by a larger number of delegates than Great Britain. At the opening official reception, H.R.H. the Crown Prince of Roumania was present and, later, representative delegates were entertained by their Majesties the King and Queen at the Royal Palace at Smaia.

Apart from the work of the special committees which met in the mornings and afternoons, a discussion on "The Nitrogen Problem," in which Prof. F. Giordani of Naples and Prof. D. Staehelin of Bucharest took part, was of special interest in connexion with the natural resources of Roumania. Public lectures were also delivered by Prof. Charles Moureu and Prof. Ernest Fourneau on "Autoxidation and Catalytic Phenomena" and "The Relationships between the Chemical Constitution of Substances and their Physiological Properties" respectively.

At the closing meeting, Prof. Ernst Cohen of Utrecht was unanimously elected president of the Conference in succession to Sir William Pope, who, like his predecessor, Prof. Moureu, has held this important office during three years. Mr. Jean Gérard was re-elected secretary and the following were appointed vice-presidents for the ensuing year: Profs. Bertrand (France), Minovici (Roumania), Nasini (Italy), Norris (America), Pictet (Switzerland) and Swarts (Belgium). The invitation from the United States to hold the next conference in Washington in September 1926, on the occasion of the fiftieth anniversary of the American Chemical Society, was cordially accepted.

An unique opportunity of seeing something of the enormous natural resources of Roumania was afforded to the delegates by the visits to the factories at Medias and Diciosanmartin, where natural methane is used not only as a source of heat and power, but also for the production of cyanamide. At the present time, the economic development is in its infancy, and there are still great possibilities for the scientific exploitation of methane of 99 per cent. purity issuing from the earth at a pressure of 20 to 30 atmospheres. The oil refinery of the Steaua Romana Company and the famous salt mines at Slanic were also inspected, and at all these places the same kindliness and hospitality were freely extended to the delegates.

The Bucharest conference was a model of efficient organisation, and Prof. Minovici and his committee have earned the sincere thanks of those privileged to attend and to join in the excursion to Constantinople, which was a *grand finale* to a most wonderful experience. C. S. GIBSON.

Wheat Supply and Demand.[1]

THE three issues of "Wheat Studies" noticed here form the preliminary instalments of a monthly series which the notice states is "designed to give a sound, impartial review of the world wheat position and outlook, based upon careful analysis of the various elements in the situation, with due recognition of economic conditions in exporting and importing countries." Numbers 1 and 3 form a continuous record of the vagaries of the wheat market over a period of seventeen months, when the market situation changed from that of being a buyers' to that of a sellers' market, thus allowing of contrasting conditions being compared equitably under almost uniform conditions of exchange and dietary habits.

No. 2 is a bibliography of the sources of the data upon which the main thesis is based.

The cause of low prices in 1923-24, the rise toward the end of the year, the reasons for export by Soviet Russia though crops were insufficient for home needs, and the cause of a marked increase in Oriental demand are all passed under review, and in a quite untechnical manner are explained.

Many interesting and important facts are deduced from the mass of statistics handled by the authors. Dietary changes due to better conditions among the artisan class since the War are having a significant influence upon the *per capita* consumption of wheat. In Great Britain the direction is downward, more meat being eaten, but in Scandinavia the same underlying cause promotes an upward movement owing to the falling off in rye consumption.

Figures are quoted showing that imports are not governed so much by the state of the home crop as by the state of the market. Abundant crops at home and abroad in 1923-24 were accompanied by a large increase in imports into Great Britain. Japan and China were attracted by low prices and consumed a quantity of wheat which is not likely to be a standard demand under the conditions which developed at the end of 1924. One of the most interesting sections of the survey is that explaining the effect of crop prospects changes, political disturbances of the nature of presidential elections, and geographic considerations such as the closing of navigation on the Great Lakes, on the course of wheat prices at Liverpool, Winnipeg, Chicago and Buenos Aires. A remarkably close correlation can be traced in almost all cases.

The series is the result of team-work, and very little time elapses between the data becoming available and the publication of the analysis. Under such conditions the readableness and accuracy of "Wheat Studies" are all the more praiseworthy.

[1] "Wheat Studies of the Food Research Institute, vol. i. (Stanford University, California) No. 1, The World Wheat Situation, 1923-24: a Review of the Crop Year; No. 2, Current Sources concerning Wheat Supplies, Movements and Prices: a Select List with Comments; No. 3, Developments in the Wheat Situation, August to December 1924.

Symbiotic Micro-organisms.

IN an article in *Scientia* (April 1925) Prof. U. Pierantoni, of Turin, who has taken a leading part in the investigations on physiological symbiosis, points out that recent researches in this domain have revealed the existence of micro-organisms which are not only useful but also, in the majority of cases, necessary for the life of the superior organism in which they occur, and they are transmitted from parent to offspring. These researches have also made known a new category of organs—termed mycetomes—which owe their functions to the presence in the protoplasm of their cells of symbiotic organisms, so that these by their specific activity determine the action of the organ. These symbiotic organs are glands the protoplasm of the cells of which, instead of elaborating products of secretion, foster micro-organisms which produce secretions useful to the organism.

The author states that the useful species of micro-organisms outnumber the pathogenic species. Among the examples of symbiotic organs to which Prof. Pierantoni refers are the luminous organs of cephalopods (Heteroteuthis, Rondeletia, Sepiola) which he has investigated, and the luminous organs of certain fishes (Anomalops, Protoblepharon) investigated by Prof. E. N. Harvey. He points out that these organs are simply cutaneous invaginations which harbour the micro-organisms, and that the thin walls in contact with rich vascular networks protect the cultures while the blood provides the nutrient material required by the micro-organisms. The latter multiply and produce continually new luminous substances which replace those expelled from the organ to the exterior by muscular action under nervous stimulation. In some cases, reflectors and refractors are formed from the neighbouring tissues; these render the light emitted more brilliant.

Another important group of symbiotic organs is the mycetomes in the wall of the intestine and associated organs—*e.g.* in larval and adult insects which feed on wood and blood, and in ticks—which elaborate ferments that facilitate the digestion of wood, cellulose, chitin, etc. A third group of these symbionts is chromogenic. The author observed in 1912 that in certain homopterous insects the symbiotic organ exhibited a bright colour which he attributed to the contained micro-organisms. Other investigators have recently found that the red lac of India produced by the coccid *Tachardia lacca* results from the activity of a micro organism, allied to the Blastomycetes, which has been isolated and cultivated. The absorption spectrum of red lac exhibits an affinity with that of carminic acid (from cochineal, also the product of a coccid) and of the red products of the chromogenic *Bacillus prodigiosus*. Prof. Pierantoni believes that we are only at the beginning of a line of inquiry likely to be rich in results in pure and in applied science.

University and Educational Intelligence.

BIRMINGHAM.—Applications are invited for the Walter Myers Travelling Studentship in Pathology, value 300*l*. Information concerning the studentship can be obtained from the Dean of the Medical Faculty of the University. The latest date for the receipt of applications is September 1.

BRISTOL.—In connexion with the recent meeting of the British Medical Association at Bath, the honorary degree of LL.D. has been conferred on Sir Humphry Rolleston, Bart., Regius professor of physic in the University of Cambridge and president of the Royal College of Physicians.

DURHAM.—At a meeting held on July 27 the Council of Armstrong College, Newcastle-upon-Tyne, appointed Prof. J. W. Bews, of Natal University College, Pietermaritzburg, to be professor of botany in succession to Prof. M. C. Potter, retired. Dr. Bews is a native of the Orkney Islands, and was educated at Kirkwall and at the University of Edinburgh. He has been a lecturer in botany at the Universities of Manchester and Edinburgh, and since 1910 has been professor of botany at Pietermaritzburg. His publications include "Grasses and Grasslands of South Africa" (1918), "Flora of Natal and Zululand"

(1921), "Plant Forms and their Evolution in South Africa" (1925), and numerous papers dealing with plant distribution in South Africa.

EDINBURGH.—At the Graduation Ceremonial on July 22 the following were among the honorary degrees conferred:—*LL.D.*: Brig.-General the Hon. C. G. Bruce, chief of the Mount Everest Expedition; Prof. A. S. Eddington, Plumian professor of astronomy and natural philosophy in the University of Cambridge; Prof. R. Muir, professor of pathology, University of Glasgow; Principal C. Grant Robertson, University of Birmingham; Sir H. J. Stiles, Regius professor-emeritus of clinical surgery in the University of Edinburgh.

The degree of *D.Sc.* was conferred on the following:—Mr. A. C. Aitken (Thesis—"The Graduation of Observational Data"); Dr. F. J. Browne (Thesis—"Observations on Still-Birth and Neonatal Death, their Causes, Pathology and Prevention"); Mr. A. T. Cameron (Thesis—"Contributions to the Bio-Chemistry of Iodine and the Thyroid and Related Problems"); Mr. G. Harrower (Thesis—"A Study of the Hokien and Tamil Skull"); Mr. J. B. Shoesmith (Thesis—"The Influence of the Nature and Position of Atoms in Organic Compounds on the Reactivity of other Atoms in the Molecule").

LONDON.—Mr. J. S. Huxley, fellow of New College, Oxford, and senior demonstrator in the Department of Comparative Anatomy, has been appointed to the University chair of zoology tenable at King's College. Prof. Huxley was educated at Balliol College, Oxford, where he was Brakenbury Scholar, and also studied at the Stazione Zoologica, Naples, and at Munich and Heidelberg. From 1913 until 1919 he was assistant professor of biology in the Rice Institute, Texas, where he entirely organised the Department of Biology. He helped to organise and took part in the first Oxford Expedition to Spitzbergen in 1921, and in 1924 he visited numerous universities in Canada and the United States. His publications include: "The Individual in the Animal Kingdom" (1911), "Essays of a Biologist" (1924), and numerous papers in the Philosophical Transactions and Proceedings of the Royal Society, the *Quarterly Journal of Microscopical Science*, and in other scientific journals; he is also assistant editor of the *British Journal of Experimental Biology*.

Dr. L. Rodwell Jones, Cassell lecturer in commerce in the London School of Economics, has been appointed to the University chair of geography tenable at the School.

Mr. E. C. Titchmarsh, senior lecturer in mathematics at University College, has been appointed to the University readership in mathematical analysis tenable at the College. Mr. Titchmarsh had a distinguished career in mathematics at Balliol College, Oxford, and is the author of numerous papers in the Proceedings of the Royal Society, London Mathematical Society, and the Cambridge Philosophical Society.

The title of reader in medical protozoology in the University has been conferred on Mr. J. G. Thomson, lecturer in protozoology at the London School of Tropical Medicine since 1914, in respect of the post held by him at the London School of Hygiene and Tropical Medicine. He has held the following posts:—Durning Lawrence Research Fellow, 1909, and Clinical and Pathological Research Fellow, 1913, Liverpool School of Tropical Medicine; Beit Memorial Fellowship, 1914; Protozoologist, Central Laboratory, Alexandria, 1915; Pathologist, 17th General Hospital.

The Degree of D.Sc. in botany has been conferred on Mr. Krishnadas Bagchee (Imperial College—Royal College of Science), for a thesis entitled "Cytology of the Ascomycetes. *Pustularia bolarioides* Ramst. I. Spore Development."

THE Association of University Teachers announces in the June number of the *University Bulletin* the constitution of a Joint Standing Committee and inquiry office for promoting co-operation between university libraries. The inquiry officer is Mr. L. T. Oldaker, The Library, University, Edmund Street, Birmingham. Another interesting announcement which appears in the *Bulletin* is that the Council of University College, Reading, has decided, following the example set by Birmingham and already followed by Armstrong College, to form a standing Research Board to take responsibility for the promotion of research and the allocation of available funds. Evidence of the strength of the movement for promoting associations of university *alumni* and *alumnæ* is afforded by the announcement that the membership of the Leeds University Old Students' Association has increased since February 1924 from 500 to 1000.

THE Air Ministry announces that seven hundred aircraft apprentices, between the ages of fifteen and sixteen and a half years, are required by the Royal Air Force for entry to the Aircraft Apprentice School at Halton, Bucks, in January next. These apprentices, who must be well educated and physically fit, will be engaged as the result of two examinations, one an open competition conducted by the Civil Service Commissioners, and the other a limited competition carried out by the Air Ministry in conjunction with the local education authorities throughout the country. Since the aircraft apprentice scheme was inaugurated in 1920 approximately 2000 boys have completed their training and are now at work in service squadrons both at home and abroad, while approximately 3000 boys are now regularly undergoing training. Application to sit in the open competition must be made to the Secretary, Civil Service Commission, Burlington Gardens, W. 1, not later than September 3. Candidates for the limited examination should make application, if they are still at school, to their headmasters with the view of securing a nomination from the education authority responsible for the school. If they have left school, application should be made to the Advisory Committee for Juvenile Employment in their area. Applications must be received by the Air Ministry from nominating bodies by October 6. The syllabus for both examinations consists of mathematics, experimental science, English and a general paper. Copies of the regulations for entry (A.P. 134) can be obtained on application to the Secretary (M. 1), Air Ministry, Kingsway, W.C.2.

EDUCATIONAL research in America is greatly helped and stimulated by the publication by the Bureau of Education at short intervals of up-to-date bibliographies. We have just received a 30-page pamphlet giving some 500 references on higher education. There are no less than twenty references on the application of intelligence tests to candidates for admission to college and to undergraduates. In Columbia College intelligence tests have been used continuously since 1919 and have been found very useful. The Thorndike test of intelligence for high-school graduates has been found the best single criterion for admission to the college, and the Thorndike special intelligence test, used in the Columbia Law School, predicts success in the school better than the average college grade does. These and other similar data were published in an article by the assistant professor of educational research in Columbia University contributed to the March issue of *School Life*.

Early Science at Oxford.

August 5, 1684. A Discourse of Sir William Petty's, oncerning Land Carriages, was read

A Discourse concerning Digestion, and ye ferment f ye stomach, drawn up by Mr Lee of Brazennose ollege, was read, and will be printed in a little time

Some Seawater sweet'ned lately by Dr Plot, Mr ee, and Mr Musgrave, was shewn ye Society, and udged to be not in ye least salt to ye tast, and fit for se

Dr Plot presented ye Society with some of ye *ndes*, from ye Coast of Guinea, of which substance e inhabitants make their bread, and severall meats, : seems to be a round seed He also comunicated ome sawdust of a wood from Jamaica (ye name of hich as yet wee know not) which being put into old water, did in some few minutes tinge the water f a delicate mulberry color

Dr Gibbons gave ye Society an account of a well ear Cambden ye water of which (as he is informed) nges with galls a day or two after it is taken from e spring then intermits for eight or ten days, and fter that tinges again he promises a more full ccount of this matter An Account of ye weather e last month, taken (as usually) according to Dr ister's scheme, was brought in by Dr Plot

The Society was informed, that Mr Lee of Brasenoze ollege has lately received a letter from a friend of his i Lancashire, who lived severall years at Tangier, nd assures him that, during ye time of his stay ere, he enquired into ye nature of ye current at ye treights Mouth, by letting fall lines with weights at e end of them, and that, which way soever ye upper urrent went ye lines were driven outwards of hich he sent this account to Mr Lee, takeing ye casion from what he finds printed by Dr Smith i ye Transactions concerning this Subject, This natter will be farther enquired into, and (if possible) relation of it be had under ye gentleman's hand

August 12, 1684 Ye Minutes of ye Dublin Society om June ye 9th, to July ye 21st, 1684, being ead distinctly, and considered, it was ordered that Mr Ash and Mr Molineux be desired to impart their bservations on ye last solar ecclipse, to be printed ith those made at Greenwich, and Oxon

It is also desired, that Mr K— would be pleased to ommunicate an account of his Mesolabe Ordered hat Dr Pitt be desired at his leisure to draw up and ommunicate to this Society, his thoughts concerning igestion

Sr Wm Petty's paper of Land carriages, read ye ast Meeting, enquiring into ye reason of ye Dishing f Cart-wheels, Mr Walker was pleased to comunicate these lines concerning it (*One* reason of e Dishing of Cart-wheels seems to be this, when ne wheel falls into a Hole, or deep cartrut, so that ost of ye weight lyes upon it, then ye lower part of hat wheel stands more perpendicularly to ye plain f ye Horizon, and consequently bears ye weight etter than if ye wheel were plain, and not dish't)

A letter from Dr. Turberville of Salisbury was read, gave an account of ye three following cases

1 The *Bursa Oculi*, which was in ye white of ye ye, under ye upper lid, an empty purse, no matter t it, and hung flagg about ye length of a thumb nail

2 Another had no visible disease in his eyes, but ould not see at all without squeezing his nose with is fingers, or saddling it with narrow spectacles, and hen he saw very well him ye Doctor carried to Mr Boyl 3 Another from Banbury, a Maid of 22 or 3 years old, could see very well, but no color, besides lack and white. She saw Scintillations by night, hat much terrified her.

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Societies and Academies.

LONDON

Royal Anthropological Institute, June 9.—Shams-ul-ulama Dr. Jivanji Jamshedji **Modi**: The daily life of a Parsee of the seventeenth century, as described in the Persian Farziât-nâmeh of Dastur Darab Pâhlan. The daily religious duties began with early rising at the crowing of the cock (a sacred bird, not to be killed for food, and even requiring a kind of sacred burial), followed by a recital on, or very near, the bed, of Ashem Vohu, a sacred formula of prayer in praise of Asha (Sanskrit *rita*; English, right). This was followed by the application, on the exposed portions of the body, of *nirang* or *gaomiz*, *i.e.* the urine of a cow (*gao*), held by the ancient Aryans as a purifying substance. The application was followed by an ordinary ablution or, in special cases, by a bath. This was followed by a prayer, and there were five periods during the day for such obligatory prayers. The ablution or bath was accompanied by the untying and re-tying of the *kusti*, or sacred thread, which a Parsee had always to put on, on a sacred shirt, as symbols of his religion. The ablutions with the requisite ritual were required after calls of nature and before meals, which began with the recital of grace. A morsel was set apart for the dogs of the house or street, semi-sacred animals useful for various purposes. For his daily diet meat may be used as little as possible, and, for that purpose, not healthy but weak animals were to be killed. It was his duty to kill noxious creatures such as serpents, scorpions, mice, and the like. All kinds of scepticism in religious matters were to be avoided. A serious and solemn view of all daily actions had to be taken, and recitals of prayers for the blessing of God upon them were required. The day ended with a recital of prayers.

Linnean Society, June 11.—W. **Bateson**: Pelargoniums and the production of bud-sports. Sports are probably due to the emergence of a distinct, previously existing component, originally formed by somatic segregation at an early stage. Not very rarely the hidden component, perhaps most often a dominant, forms the central core of a periclinal system, emerging regularly in buds formed adventitiously on roots of inverted plants. Not improbably the whole root belongs to the inner component. Mosaic chimæras with islands showing a dominant also occur. A growing point arising in such an island forms a periclinal with the dominant external. The core on emergence is frequently still mosaic.—F. **Eyles**: Remarks on the flora of Southern Rhodesia. The type occupying a larger area than any other is the open forest, with trees widely spaced, not often exceeding 50 ft. in height, with a sparse undergrowth. From the ecological point of view, water is the chief controlling factor: the edaphic influence is also considerable; while temperature has less effect on distribution, owing to the relatively small degree of local and seasonal variation. Rainfall occurs in two clearly defined seasons, namely, six months of wet season and six months of dry season; therefore all perennials must be adapted to face and survive six months of drought every year. This necessity is met in the usual way.—W. **Garstang**: On the origin of the crustacean carapace. The cephalic shield is regarded as having arisen as a larval organ, in response to larval needs. It is assumed that the proximate ancestors of Crustacea, prior to the development of a cephalic shield, were essentially trilobites of lower Cambrian type, and that the larvæ were discoidal and fitted only for

flotation. Thus the so-called "typical" nauplii of Copepoda, etc., with powerful rowing antennæ, are less primitive than the discoidal small-limbed nauplii of Limnetis and Cirripedia. On the development of post-cephalic segments, the trunk-rudiment sinks below the plane of the head, and the head repairs the breach in its suspensory disk by an outgrowth from behind. This is claimed to have been the origin of the carapace—a larval adaptation to lengthen the pelagic phase. Finally, on the larvæ sinking to the bottom, the carapace, as a result of its successive adaptations to pelagic conditions, was a structure big enough to be made use of for a variety of modes of adult life

Mineralogical Society, June 16.—A. **Hutchinson**: (1) The use of the stereographic protractor for the interpretation of Laue crystal photographs By a slight modification, the stereographic protractor previously designed by the author can be used for the interpretation of Laue photographs. (2) The use of alignment charts in crystal optics. The alignment charts in common use amongst engineers can be applied to the calculation of refractive indices measured on the total refractometer.—H. E. **Buckley** and W. S **Vernon**: The crystal-structures of the sulphides of mercury. The powder method of X-ray analysis showed that the precipitated black sulphide is cubic, with the symmetry of the natural metacinnabarite and with an arrangement of atoms like that of zinc blende, $a = 5{\cdot}85$ Å.U., d (Hg-S) $= 2{\cdot}54$ Å.U. In cinnabar the arrangement of the mercury and sulphur atoms is a rocksalt one, slightly compressed along the trigonal axis and with a slight readjustment of atoms parallel to the basal plane, $a = 4{\cdot}16$ Å.U., $c = 9{\cdot}54$ Å.U., $c/a = 2{\cdot}291$. The type of movement in best agreement with the symmetry is D_3^4. In cubic mercuric sulphide each atom has four oppositely charged neighbours at a distance of $2{\cdot}54$ Å.U., while in cinnabar two neighbouring atoms are situated at a distance of $2{\cdot}54$ Å.U., as in the cubic mercuric sulphide, and two others at a distance of $2{\cdot}91$ Å.U. These facts indicate an eccentricity of the mercury atom if the sulphur atoms are regarded as spherical. In cinnabar, in accordance with the circular polarisation, sulphur atoms run down through the structure in trigonal spirals.—Edmondson **Spencer**: Albite and other authigenic minerals in limestone from Bengal. The limestones of Cuddapah age near Raipura, Bengal, contain well-formed crystals of pure albite, apparently authigenic in origin. The crystals are tabular on the brachy-pinakoid and are lozenge-shaped. They are twinned on Carlsbad and albite laws similarly to those of the well-known Roc-tourné type, but of different habit. Accompanying the albite are phlogopite, tourmaline, and quartz crystals, all believed to be authigenic. Comparisons are instituted with similar occurrences of felspars in limestones from various European localities.—Robert **Campbell** and J. W. **Lunn**: Chlorophæite in the dolerites (tholeiites) of Dalmahoy and Kaimes Hills, Edinburgh. The dolerites of Dalmahoy and Kaimes Hills are exceptionally rich (up to 15 per cent. or more) in chlorophæite, which occurs as a vesicle mineral, as veins, and as pseudomorphs after fayalite. The mineral has a refractive index 1·498, hardness 1·5, and density 1·81; it has no cleavage and is isotropic. It shows on exposure a striking colour change from bright olive-green to black, due to rapid oxidation. From its physical and chemical characters the mineral is regarded as of a colloidal nature.—L. J. **Spencer**: Tenth list of new mineral names; with an index of authors.

Royal Meteorological Society, June 17.—J. E. **Clark**, I. D. **Margary** and R. **Marshall**: Report on the phenological observations in the British Isles from December 1923 to November 1924. In this thirty-fourth report, 365 sets of records are discussed; compared with about 120 before 1922; the N.W. half of Ireland and most of West and North Scotland are still practically bare. The year was described officially as "Dull and very wet with a very cloudy summer." Again it began mild, the four weeks to February 10 averaging 6° warmer than the succeeding four. Sudden heat-bursts again raised false hopes, and made the records of plants, insects and birds again erratic. Almost everything was much later than in 1923, and on the 30 years' average, flowers in the E. and S.E. were one to two weeks late; N. England and Scotland still more. Yet the hazel was early; blackthorn, eleven days behind in S. Britain, latest of all. Insects, appearing later, ranged from 18 days late for the honey bee to three only for the Orange Tip, with the Meadow Brown in June a week early: so too the migrants. Vegetable growth was exceptionable, and little troubled by insect plagues, though slugs, snails and fungoid troubles were bad. Tree fruit was scarce and of poor quality. Grain and hay were saved with difficulty; potatoes were often diseased, but green crops and roots were some compensation.—D. N. **Harrison** and G. M. B. **Dobson**: Measurements of the amount of ozone in the upper atmosphere. Following the general method of Fahy and Buisson, the amount of ozone present in the atmosphere has been measured by spectroscopic means. A marked connexion is found between the amount of ozone and the general pressure distribution at the surface, and a still closer connexion with the conditions at about 10 km.—J. **Baxendell**: Meteorological periodicities of the order of a few years, and their local investigation; with special reference to the term of 5·1 years in Britain. The following meteorological periodicities seem to be established: 5·1, 3·1, 2·8, 2·4, 2·2, and 1·63 years. Working on foreign and feebler English cycles, several of the shorter terms appear to be exact half-harmonics of certain of the longer ones; while there are also third-harmonic components. The 5·1-year term was found at Southport in the 'eighties, and has since been independently detected by five investigators elsewhere, two of whom have traced it back for three centuries. It is especially pronounced in the frequency of the colder wind-directions, in Lancashire and at Greenwich; but values for the term in rainfall, temperature, air pressure, severe winters, and other data, are also given.

Geological Society, June 24.—W. J. **Sollas**: On a sagittal section of the skull of *Australopithecus africanus*. Sagittal sections of the skulls of the anthropoid apes, the Hominidæ, and the Taungs skull, show that the last-named presents numerous and important characters, by which it differs from the anthropoids and makes some approach towards the Hominidæ. The claims of Australopithecus to generic distinction are justified.—D. **Parkinson**: The faunal succession in the Carboniferous Limestone and Bowland Shales at Clitheroe and Pendle Hill. The rocks form that portion of the south-eastern limb of the Clitheroe anticline which is included between the Twiston and Clitheroe faults, along with most of the scarp-face of Pendle Hill. The lowest beds appear to be of Z age, but the junction of Z and C is an uncertain horizon. The knoll-limestones pass laterally into shales and crinoidal limestones. The Worston Shale series is overlain by the *hodderense* goniatite-band, which forms a constant feature along the foot of Pendle Hill. The Pseudobilinque zone terminates below the Pendle Grit, where another goniatite (possibly *H. leion*) appears, and forms a continuous horizon just below the grit. It is suggested that the

base of the Upper Carboniferous should be drawn here. The Worston shales appear to have been deposited on a very uneven sea-floor, the irregularities being due to the mode of accumulation of the limestones, and not to interformational uplift and erosion.—Miss J. M. M. **Dingwall**: Cyathoclisia: a new genus of Carboniferous corals. Certain Tournaisian corals of limited range, which are fairly abundant in certain localities in the south-west of England and South Wales, are described. These forms agree with Clisiophyllum in their general features, but differ so markedly from the Viséan species of the genus in structural details that it has been assigned the new generic name, Cyathoclisia, suggested by Dr. W. D. Lang. The members of this genus are simple rugose corals. One species, *C. tabernaculum*, shows remarkable variability; it appears to have a limited distribution, both horizontally and vertically. So far as is known, it is confined to the south-western province of the Carboniferous Limestone. Cyathoclisia may have been developed from Palæosmilia.

PARIS

Academy of Sciences, June 29.—A. **Lacroix**: The meteorites of Tuan Tuc (June 30, 1921) and of Phu Hong (September 22, 1887) in Cochin China. In the Tuan Tuc fall there were two meteorites found at a distance of 40 kilometres apart. These were similar, being olivine and hypersthene chondrites. The Phu Hong meteorite was a chondrite containing olivine and bronzite.—H. **Deslandres**: Complementary researches on the structure and distribution of band spectra.—G. **Bigourdan**: The topographical influences which affect the pendulum corrections employed at the B.I.H.—A. **Haller** and R. **Cornubert**: The constitution of dimethylcyclopentanone and of dimethylcyclohexanone in which alkyl groups have been introduced by the sodium amide method.—Gabriel **Bertrand** and M. **Mâchebœuf**: The proportions of cobalt contained in the organs of animals. Cobalt is found along with nickel in the organs of man and animals. Numerous data are given, together with the methods adopted for the determinations. The mode of distribution of the cobalt in the various organs is approximately parallel to that of nickel.—Charles **Richet**, Eudoxie **Bachrach**, and Henry **Cardot**: The hereditary fixation of acquired characters, proved by the stability of the displaced thermal optimum. After cultivating the lactic ferment over a long period in a medium containing a large proportion of potassium chloride, a lactic bacillus is obtained possessing two new characters; resistance to potassium chloride is increased and the thermal optimum is strongly displaced in the direction of a higher temperature. These acquired characters have proved to be stable.—Rollet de l'**Isle**: The method of elaboration and of publication of international scientific and technical vocabularies.—R. H. **Germay**: The periodic integrals infinitely near partial differential equations of the first order.—Armand **Cahen**: The continued fractions attached to operations about one unit above or below.—Léon **Pomey**: The determination of the integrals of differential equations by general initial conditions.—J. L. **Walsh**: The position of the roots of integral functions of genus one and zero.—D. **Menchoff**: The summation of series of orthogonal functions.—G. **Fayet** and A. **Schaumasse**: The next return of Borrelly's periodic comet (1905 II. = 1911 VIII. = 1918).—André **Planiol**: The calculation of the yield and heat balance of explosion motors.—Louis **Breguet**: The output from apparatus utilising the energy of the wind.—G. **Bouligand**: An approximate method for studying the movement of certain vortex rings.—**Marcelin**: Superficial solutions and the law of Gay-Lussac.—René **Delaplace**: The extension of the law of Gay-Lussac to superficial solutions.—L. **Riéty**: The electromotive force of filtration. Aqueous solutions (1 per cent.) of various iron salts, forced through a glass tube under a pressure of 25 atmospheres, gave rise to potential differences between −0·070 volt and +0·21 volt. The results are discussed from the point of view of the rules given by Perrin. The solubility of the glass and the hydrolysis of the salts employed influence the sign of the electric charge.—E. **Delcambre** and R. **Bureau**: The propagation of short (Hertzian) waves. Details of the peculiarities noted for distances between 1500 and 10,000 kilometres in the propagation of short waves emitted by a transmitting station installed on the vessel *Jacques-Cartier*.—A. **Perot** and M. **Collinet**: The variation of the wave-length of the absorption lines of iodine with the density. The same weight of iodine was placed in two tubes of the same diameter but of different length, both being heated in the same electric furnace to 180° C. The variation of the wave-length was measured by a new interference method.—Pierre **Daure**: The determination of Avogadro's constant by means of the light diffused by ethyl chloride. The value found was $N=(6\cdot5+0\cdot65)10^{23}$.—R. de **Mallemann**: The diffusion of light and Kerr's constant.—L. **Meunier** and André **Bonnet**: The fluorescence of fisetine in Wood's light applications. Certain bark extracts taken up on acetyl cellulose give a characteristic fluorescence in Wood's light. The reaction has applications in analysis.—J. **Laissus**: The cementation of iron alloys by chromium.—R. **Hugues**: The annealing of electrolytic iron in a vacuum. The iron was heated in an electric furnace specially designed to reduce leaks due to porosity. Data are given showing the amount and composition of the gases evolved, and changes in magnetic and mechanical properties.—Gérard H. **Lafontaine**: Contribution to the study of the equilibrium of magnesium carbonate in ammoniacal solutions.—A. P. **Rollet**: The solution of nickel in sulphuric acid under the influence of the alternating current.—J. **Errera** and Victor **Henri**: The quantitative study of the ultra-violet absorption spectra of the dichlorethylenes. The *trans* derivative absorbs more than the *cis*, and the difference increases for the shorter wave-lengths. The absorption differences are the same in the pure liquids as in solution in hexane or in alcohol.—L. **Royer**: The regular joining of crystals of different species.—E. **Rothé**, J. **Lacoste** and Ch. **Bois**: Seismological observations made on the occasion of a violent explosion. Advantage was taken of the detonation of 3250 kilograms of high explosive in a mine to carry out seismological observations with two types of apparatus, a seismograph of the Mainka type installed in a mine five kilometres from the place of the explosion, and a 19-ton pendulum recently set up in Strasbourg seismological station 142 kilometres from the explosion. The latter instrument gave 2600 metres as the velocity of wave transmission.—P. **Lavialle**: The nutrition of the embryonic sac in *Knautia arvensis*.—Raoul **Combes**: The migration of nitrogenous substances from the leaves to the stems in the course of autumn yellowing.—F. van **Gaver**: Concerning the bony head and dentition of a young Asiatic elephant.—Emile F. **Terroine**, Mlle. S. **Troutmann** and R. **Bonnet**: The energy yield in the growth of micro-organisms as a function of the concentration of the nutritive substances of the medium and the food excess present.—Mme. L. **Randoin**, J. **Alquier**, Mlles. **Asselin** and **Charles**: The food equilibrium and relative proportions of mineral salts and glucides of a ration.—L. J. **Henderson**: The application of the nomographic method to the study of the

respiratory phenomena in the blood.—**Caridroit** and **Pézard**: The autonomous testicular growth in the interior of autoplastic ovarian grafts in the domestic fowl.—S. **Kostytschew** and A. **Ryskaltchouk**: The products of the fixation of atmospheric nitrogen by *Azobacter agile*. The experiments lead to the conclusion that the Azobacter produces ammonia by the direct reduction of atmospheric nitrogen: the ammonia is afterwards utilised for the synthesis of amino acids.—A. **Blanchetière**: The colour reactions of tryptophane with aldehydes.—Raymond **Hamet**: A new case of inversion of the effects of adrenaline.—René **Fabre** and Mlle. E. **Parinaud**: Study of the dissociation of the salts of narcotine and the best conditions for the extraction of this alkaloid in toxicology. It is possible to extract with organic solvents the whole of the narcotine from solutions of its salts. This is due to the marked dissociation of the salts in solution.—**Vernadsky**: The pressure of living matter in the biosphere.—L. **Fage** and R. **Legendre**: The swarms of a polychetal annelid (*Polyophthalmus pictus*) observed while fishing with a submerged light.—Arthur **Grimberg**: The treatment of external tuberculosis by a colloidal extract of Koch's bacilli. Details of the treatment are given; it has cured more than 50 per cent. of the cases and improved the condition of a further 25 per cent.—Et. **Burnet**: The differentiation of Paramelitensis by flocculation under the action of heat.

CALCUTTA.

Asiatic Society of Bengal, May 6.—C. J. **George**: Root sucking aphids of Coimbatore.—C. **Chilton**: The Amphipoda of Tale Sap. This is an instalment of the "Zoological Results of a Tour in the Far East." Eleven species are examined. Of these nine are the same as those from the Chilka Lake. One species is described as new. Two additional species from other localities are included in the report: one, *Grandidierella gilesi* from Patani River, a short distance to the south, on the same coast as Tale Sap; the other, *Colomastix pusella*, from Port Weld, on the other coast of the Peninsula.—D. N. **Majumdar**: The traditional origin of the Hos, together with a brief description of the chief Bongas (Gods) of the Hos.—Hem Chandra **Das-Gupta**: A few types of sedentary games prevalent in the Central Provinces. The plays described are *atharaguliala teora*, *dash-guli*, *gol-chuish*, *haooa*, and *sat-gol*, and the description is based chiefly on the information gathered from a few villagers of Gosalpur, in the district of Jubbulpur.—H. **Chaudhuri**: A study of a disease of garden peas (*Pisum sativum*) due to *Sclerotium rolfsii*. The causal organism was isolated from the soil and the plant tissues. Infection occurs through wounds only, and especially through wounds in the collars. The fungus was grown in various media, the P_H value ranging between 5 and 7·8; range of temperature, between 10° C. and 33° C. Light is not an important factor in sclerotium formation, but dry atmosphere is favourable. Perfect sterilisation was obtained by autoclaving soil in pots (30 lb. for ten minutes).—Satya Churn **Law**: Local names of some birds of the Manbhum District.

SYDNEY.

Linnean Society of New South Wales, March 25 (Jubilee Meeting).—R. H. **Cambage** (Presidential address): Need for a botanical and soil survey of New South Wales. The growth and distribution of native plants are regulated by many factors, and therefore it is not possible to say definitely what a soil may produce without knowing all the facts governing its situation and accompanying conditions. Subject to climate, the geological formation is a most important factor in regulating the growth and distribution of plants, and this is made manifest by the accordance in the changes of plant associations and of the rock formations. For ages the native flora has investigated the chemistry and physical characters of the soil in Nature's laboratory, and the result is available for our study and our benefit in the indigenous vegetation which for so long has been allowed to work out its own destiny unmolested by invasions of either fresh fauna or flora. Full advantage of the information at our disposal can be best achieved by a careful botanical and soil survey of our State so far as is reasonably possible.—W. F. **Blakely**: The Loranthaceæ of Australia. Part VI. Deals with 10 species and 8 varieties belonging to the subgenus Dendrophthæ; two old species are rehabilitated, and 1 species and 4 varieties are offered as new.—G. D. **Osborne**: Geology and petrography of the Clarencetown-Paterson District. Part III. A study of the main glacial beds at Seaham. The total thickness of strata is measured at 1890 feet. Some structures, produced by the dragging force of moving ice, are characteristic of glacial beds developed close to an ice-front, in contrast with the facies exhibited by glacial deposits laid down at a distance from the ice-front.—Ida A. **Brown**: Notes on the occurrence of glendonites and glacial erratics in Upper Marine Beds at Ulladulla, N.S.W. The glendonites occur in the Ulladulla mudstones, the lowest beds of a marine series, on a horizon which may be correlated with the Huskisson beds farther north. They occur in mudstones closely associated with fossil beds, but have not been found in overlying mudstones which do not contain abundant fossils.—A. **Philpott**: On a remarkable modification of the eighth abdominal segment in *Lindera tessalatella* Blanch., with a description of the male and female genitalia.

VIENNA.

Academy of Sciences, April 30.—F. **Werner**: New or little-known snakes in the State Museum of Natural History at Vienna. Four new genera and eight new species of Colubridæ are included.—C. **Doelter**: The effect of pitch-blende on mineral colours. Radium produces effects in a few days, while pitch-blende requires some months.—R. **Kreman** and K. **Zechner**: On the influence of substitution in the components of binary solution equilibria. (xlviii.) The binary systems of azobenzol with acids. (xlix.) The binary systems of cinnamic aldehyde and salicylic aldehyde with phenols. (l.) Binary systems of acids and amines by R. **Kreman**, G. **Weber** and K. **Zechner**.—R. **Kreman** and A. **Hrasovec**: Electrolytic conduction in molten metal alloys. Attempts at repression of diffusion of metals in quicksilver by means of continuous current.—G. **Weissenberger** and F. **Schuster**: Organic molecular compounds. (x.) Vapour pressure curves. (xi.) Dolezalek's theory. (xii.) With H. **Pamer**. (xii.) Chloracetic acids and penta-chlor-ethane.—J. **Zellner**: Contributions to the comparative chemistry of plants. (x.) Chemistry of barks. Elm, alder, walnut, plane-tree have been examined. (xi.) F. **Stern** and J. **Zellner**: On *Sonchus arvensis*.—W. **Konrad**: Time curves of the Tauern earthquake of November 28, 1923.

Official Publications Received.

Scientific Papers of the Institute of Physical and Chemical Research, No. 28: On the Doublets and Triplets in the Spectra of different Elements. By Yoshikatsu Sugiura. Pp. 31. 35 sen. No. 29: Sur la toxicité du thiophène pour le nickel catalyseur et une autre action du cuivre catalyseur. Par Bennosuke Kubota et Kiyoshi Yoshikawa. Pp. 33-50. 20 sen. No. 30: A Classification of Enhanced Lines of various Elements. By Masamichi Kimura and Gisaburo Nakamura. Pp. 51-69 +4 plates. 45 sen. No. 31: Classification of Enhanced Lines of various Elements. II. Spectra of Intermittent Arc shunted by a Condenser. By Masamichi Kimura. Pp. 71-79+1 plate. 20 sen. (Tokyo: Kaimeisha, [illegible])

SATURDAY, AUGUST 8, 1925.

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Universities as Centres of Chemical Research.

THE advancement of natural knowledge is the major, if not the exclusive, aim of all purely scientific societies, and to this aim they adhere as a rule very strictly. In recent times, however, events have happened which have led to a wider view being taken of the functions of science, and hence we discern an increasing tendency for presidential addresses to wander from the narrower paths of esoteric learning and to linger awhile in the more spacious avenues that lead not only to increased knowledge, but also to improved social welfare. Progress is determined by the interplay of many factors, intellectual as well as moral and physical, and leaders in the pursuit of new knowledge can do much towards its realisation if they possess their share of the tribal conscience and have the necessary courage to speak out.

Of the many problems that touch both science and social welfare, that of research is one of the most fundamental, and in selecting this topic for his presidential address to the Chemical Society, as well as for his skill in handling it, Prof. W. P. Wynne deserves our thanks and congratulations. In this address[1] he reconsiders in the light of recent happenings the observations and conclusions expressed by Prof. R. Meldola when he spoke from the chair in 1907. In the opinion of the latter the output of research work was not "representative of the productive capacity of the nation," and the "enormous submergence of research talent" then existing was due mainly to the few openings offered by industry, the low salaries paid to junior university teachers, and to poverty compelling promising students to leave the university immediately after graduation. The one bright spot in the somewhat dismal scene was the existence of scholarship schemes associated with the Royal Commissioners of the Exhibition of 1851, the Salters' Company and the Carnegie Trust, through which men of approved ability were enabled to carry on original work after finishing their college training.

Prof. Wynne's diagnosis of the present situation agrees in the main with that of his predecessor: both indicate that lack of sufficient funds is responsible for most of our present-day defects and deficiencies. In two tables Prof. Wynne presents statistics relating to the output and distribution of chemical research in the British Isles during the three sexennial periods 1901–6, 1908–13, and 1919–24. The original chemical memoirs published in the leading chemical journals and in the Proceedings of the Royal Society, and emanating from higher educational institutions, numbered 865, 1271, and 1464 in the respective periods.

[1] Journal of the Chemical Society, vol. 127, April.

To these totals the Universities of Oxford, Cambridge, and Manchester, together with the Imperial College (Royal College of Science and C.T.C.), contributed, collectively, 33·8, 36·5, and 34·8 per cent., the London colleges, modern English universities, and Welsh, Scottish and Irish universities, 57·8, 53·2, and 56·1 per cent., whilst the technical colleges accounted for only 8·4, 10·3, and 9·1 per cent. The persistent comparative sterility of the technical institutions is ascribed to the unenlightened outlook of the governing bodies concerned; and the approximate uniformity in the number of contributions from each of the three groups is regarded as accidental.

Interesting as the detailed figures given in the printed address undoubtedly are, their significance must not be overestimated. In the first place, it may be doubted whether numbers of papers published can afford an unambiguous index of research activity. The criticism is often heard that modern workers are far too prone to publish small instalments (scraps !) of work at frequent intervals, rather than to wait until their investigations have attained a reasonable degree of completeness. Publication of original research has become an almost indispensable condition of promotion in the academic sphere, and hence the young worker seeking notoriety and quick promotion may publish half-a-dozen small contributions in the same interval of time when a classical worker of the old school might have published only one. Secondly, the statistical method used by Prof. Wynne takes no cognizance of quality, and quantity without quality is of no greater moment in science than in art or morals. Whilst, therefore, we may agree that Prof. Wynne's figures warrant the conclusion that there has been a steady increase in the volume of chemical research—though not to the extent implied by the figures—there is nothing to indicate that there has been any corresponding increase in value. The statistical method very often breaks down when applied to things of the spirit.

In not repeating or endorsing his predecessor's opinion concerning the output of work being incommensurate with the productive capacity, Prof. Wynne takes a wise course, because the question of productive capacity in the intellectual sphere must be very largely a matter of conjecture, and unless we have some fairly accurate means of measuring, it must be wrong to predicate any quantitative relationship between output and capacity to produce. The belief may, however, be justified that, following the extension of educational facilities in our secondary schools, due to the enactment of the Fisher proposals, capacity for research is being increasingly developed, or rather, that those gifted with it are not being overlooked to the same extent as formerly. Unfortunately, secondary education shares with university education the same handicap of lacking adequate financial resources, and therefore until better times arrive, both have to cut their coat strictly according to their cloth, compromise, and postpone enterprises of great pith and moment.

Prof. Wynne recalls that the university colleges passed their early lives in poverty, so that their administrators came to judge the success and the needs of departments by the number of students working in them, and to regard all departments as of equal value and importance; and these views still persist. The relatively high cost of maintaining laboratories remains an added handicap to scientific departments, and it is suggested that in allocating grants, more consideration should be given to the number of post-graduates engaged in research, and to the number of hours actually spent in teaching. Science demonstrators and assistants have to spend long hours in the laboratory, and therefore they should be given more free time for their own work. Since, however, the universal call for economy rules out any increases in staff, it is of fundamental importance to inquire whether greater efficiency could not be secured by abandoning the present policy of allowing each university to attempt to excel in many branches of pure and applied science, and by substituting therefor more localisation and greater concentration of effort.

For the old-established scholarship schemes for post-graduate research work Prof. Wynne has nothing but praise; the figures he gives show that far more scholarships are awarded for chemistry than for any other science. The Beit Memorial Fellowship and the Ramsay Memorial Fellowship Trusts have increased considerably the sums available for this work, whilst the Department of Scientific and Industrial Research, by giving maintenance grants for training in research methods, "has done a service to science and the country so great as to be almost incredible in the light of pre-War neglect." Its annual expenditure since 1920 in grants for research training in branches having industrial applications has been between 40,000*l*. and 50,000*l*.

The institution of the Ph.D. degree for research work was a war-time measure, originating in the desire to attract to our universities students from the Overseas Dominions and foreign countries who formerly would have studied in Germany. It was recognised at the outset that success of the scheme for such a degree would depend mainly upon the expenditure of large public funds to improve the equipment of our laboratories and to provide increased amenities for the students; such expenditure has, unfortunately, not been found possible. A serious blemish in the regulations for this degree is the non-provision of travelling scholarships for home students, as the

alue to them of change of environment is very eat. Since there is no immediate prospect that this ffect will be remedied, Prof. Wynne suggests (1) that ie Department of Scientific and Industrial Research ould only renew its grants after the first year to udents who migrate to another institution; (2) that ie grants be renewable for a third year; and (3) that uring the two years' absence from home the maintenance grant be increased.

Despite the acute and prolonged depression in trade, re has been a distinct change in outlook with regard the employment of trained research chemists in stry, and for this the institution of research ociations by the Department of Scientific and Industrial Research is largely responsible. Manufacturers, wever, still complain of the inefficiency, from the rks point of view, of the university-trained man; it, asks Prof. Wynne: Are the universities entirely to ame? What opportunities do industrial firms offer n for testing his vocation while there is yet time for n to make another choice? Is it not possible to ow selected students to spend some part of each long cation in the works, not necessarily in the laboratory, t under foremen on the plant? The common objecns relating to the violation of secrecy and interference th routine have been successfully overcome in effield, where the presence of intending graduates welcomed in the steel-works during the long cation. There seems no valid reason why the exple of Sheffield firms should not be followed in ier centres and in other industries.

Finally, Prof. Wynne appeals to the Association of itish Chemical Manufacturers to assist and co-operate th the universities in such matters. He recalls the t that the Chemical Society took a leading part in nching the Association, but he did not mention, as might have done, that the conferences of the emical societies which led to its foundation were ivened to consider the best methods, not only for omoting co-operation among chemical manufacturers, t also co-operation "between them and the teachers universities, colleges, and technical schools." The sociation has admittedly done good work for the nufacturers, and in support of Prof. Wynne we ture to express the hope that it will add to its by working with and assisting institutions of her education. As Prof. Wynne says, "University industry—theory and practice—obviously must borate if the chemical industry of this country to make headway in face of present difficulties"; eed, without the co-operation of the universities, industry can neither hope to prosper in times of te international competition, nor fulfil its patriotic igations in times of international strife.

National Art in the Stone Age.

Urgeschichte der bildenden Kunst in Europa, von den Anfängen bis um 500 vor Christi. Von Moritz Hoernes. Dritte Auflage, durchgesehen und ergänzt von Oswald Menghin. Pp. xix + 864. (Wien: Kunstverlag Anton Schroll und Co., 1925.) 30 gold marks.

ALTHOUGH written history begins in Europe two thousand years later than in Egypt or Mesopotamia, the archæological record is nowhere longer or more continuous. Art is more the object of the archæologist than the philologist; and in this domain Europe is exceptionally rich. The men of the Old Stone Age decorated bones or cave walls with marvellous drawings which recall to life an extinct fauna. But the naturalism of palæolithic art passed away with the advent of more modern climatic conditions; in France and Spain, the centres of quaternary art, only conventionalised and æsthetically worthless survivals are to be found on the walls of Copper Age cave-shelters and dolmens. Only in the extreme north did a naturalistic art, stylistically if not genetically akin to that of the cave-men, persist throughout the New Stone Age among backward food-gathering tribes. From that period, which saw the establishment of food-producing economy, no artistic products have elsewhere come down to us save geometrically decorated vases and rude clay figurines.

The same geometric character pervades continental art in the Bronze and early Iron Ages. But in the Ægean in the seventeenth century B.C., a new and deliberate naturalism arose under the shadows of the Cretan palaces, only to fall a prey to conventionalism and eventually to become geometric in the "Greek Middle Ages," as Hoernes happily describes the Late Mycenæan and Dipylon periods. The final revival of naturalism begins in the city-states of archaic Greece, and Etruria, then among the Celts of La Tène, and finally among the Teutons in the first centuries of our era. Hoernes saw in these transformations the reflection, not of racial, but of economic and social changes. The primitive naturalism was proper to the parasitic life of hunters. Geometric styles correspond to the symbiotic economy of peasants, and in the permanence of their designs betray the prominent part played by women in the new industries. A synthesis of the foregoing moments in a class-society wherein a "parasitic" layer of rulers, priests, and warriors has been superimposed upon the peasantry evokes the conscious naturalism of Middle Minoan Crete or La Tène. With these masterly generalisations the Viennese professor summed up abstractly the artistic evolution of our continent.

In presenting the evidence on which these conclusions

were based, Hoernes adopted an almost equally abstract method. Writing in 1914, he did not believe in the possibility of identifying racial groups by archæological data. In the ten years since his death, the immense progress of science has left the prehistorian no alternative but to adopt the concrete methods of the historian. His characters are indeed nameless and the individual still eludes him, for in the epoch with which he deals the individual was still merged in the collectivity. Prehistoric art is like modern peasant art; it is far more the product of the group, the embodiment of its æsthetic traditions, than the creation of an individual artist. On the other hand, just as peasant art in Brittany is distinct from that of the Ukraine, so the several styles of geometric decoration on neolithic pottery must be regarded as embodying the ideals of specific racial groups. Hoernes' pupil and successor, Prof. Menghin, is animated by this principle throughout the two hundred pages of his appendix. Thus even in the Old Stone Age the "impressionist" scenes painted on the rocks of southern Spain may be contrasted with the isolated realistic figures depicted farther north. This contrast illustrates the distinction between a race newly come from Africa (the Capsians) and more Eurasiatic stocks.

In the New Stone Age the archæological map of Europe discloses a veritable mosaic of cultural groups. The sharpness with which these nameless peoples stand out, the precision with which their migrations can often be plotted, will come as revelations to English readers. Pottery is now the best guide to their identification and the principal vehicle for their artistic self-expression. Thanks to Prof. Menghin, we now have for the first time a complete and reasoned account of the ceramic styles and their interrelations. The loess-lands of the Danube valley are occupied by peaceful peasants. Fine pottery adorned with spirals and mæanders defines the extent of their colonies; derivative types growing into local styles mark their gradual expansion to Poland, south Germany, and Belgium. From the west (probably from Spain, for brachycephals are found there despite Menghin's statement to the contrary) a short-headed race of armed traders introduce their bell-shaped beakers into central Europe, there mingle with a Nordic tribe, and eventually invade Britain. But the real plot of European prehistory is the victorious expansion of the "Nordic culture." The latter, Menghin frankly attributes to Indo-Germans (*i.e.* Indo-Europeans or Aryans); for he is a Germanist albeit a temperate exponent of theories often travestied by too ardent advocates. The submergence or absorption of the Danubian peasant art by that of Nordic invaders is in any case patent. It provides a truly historical explanation for that contrast between peripheral and tectonic styles of decoration upon which Hoernes based his whole treatment of neolithic pottery; for the metopic division of the vase-surface was as characteristic of the North as the free ornament was of the Danube valley.

Here, as in the analysis of west European cultures, the concentration on ceramic evidence imposed by the plan of Hoernes' work tends to hide difficulties. The internal incoherence of the "Nordic culture," notably the opposition between the separate-grave folk of inner Jutland and the megalith-builders on the Danish coasts, would have become more glaring had weapons and ornaments been considered. Conversely, chronological difficulties have been evaded by giving the "Caucasian pottery" the status of an independent group. It can, however, only rank among the subdivisions of Menghin's Nordic group; direct genetic relationship is demonstrated *inter alia* by the very peculiar type of tomb in which similar vases occur both on the Saale and on the Kuban (Menghin's printer has consistently confused this river with the Iron Age site of Koban). If the high antiquity of the latter tomb really precludes its attribution to a clan hailing from central Germany, the only alternative is to invert the direction of the journey.

If, however, the warlike Nordics must claim the attention of the historian, they have little to offer to the artist. On the other hand, the peaceful peasants of the south-east have left us monuments of real beauty —magnificent painted vases. The Thessalian group is already familiar; this well-illustrated account of the Transylvanian-Ukrainian vases and figurines will be all the more welcome. We would, however, suggest certain corrections. The most important site yet excavated—Erösd—is omitted. Now the inhabitants of this Copper Age village, nestling among the mountains of Transylvania—the ancient El Dorado of central Europe—not only decorated their vessels with polychrome spirals and mæanders but also adorned the walls of their substantial houses with frescoes and plaster mouldings. Then pottery virtually identical in technique and decoration with that of Erösd appears intrusively in a corner of Thessaly. How can Menghin deny that this intrusion marked an invasion from beyond the Balkans? In Thessaly this genuine painted fabric gives place to the curious "crusted" ware on which the colours are applied only after the burnishing and firing of the vase. The same technique is encountered in the Danube valley from Serbia to Moravia. But Hoernes and Menghin have not distinguished it from true painting, and so have missed the essential cultural continuity between Thessaly and the Danube valley at this period. In fact they treat the Danubian crusted ware as older than and partly the ancestor of

the painted pottery of Transylvania, whereas the stratigraphical sequence in Thessaly would suggest just the opposite relation. Finally, the curious way in which stylised animals come to figure among the geometric designs of the latest painted pottery in Galicia and the Ukraine is surely a phenomenon worthy of note in a history of art. However, the painted pottery appears with meteoric brilliance only to vanish utterly in the night. Perhaps the vase-painters were submerged by the same Nordic flood that had overwhelmed the peasants of the Danube valley.

The remaining ceramic groups distinguished by Menghin are of less artistic or historical significance. He finds no continuation for the mesolithic wares of the Danish kitchen middens and Campigny and, with less justification, isolates the neolithic pottery of Crete from its successors and neighbours. The artistic capabilities of the rude hunters of the extreme north are better expressed in their carvings than in their coarse vases. Finally, all the wares of western Europe and north Africa are classed together in one admittedly amorphous group. Incidentally, while flattered by the prominence accorded to English neolithic wares in the last-named group, we deplore the neglect of the richer Scottish material.

As a whole, this book with its 1462 illustrations constitutes a veritable corpus of neolithic pottery; and the art of the later periods and of the Ægean is treated with no less thoroughness and lucidity. If there be room for differences of opinion on isolated points as indicated above, that is but natural in a pioneer work on a young science; no such detailed or comprehensive survey of European prehistory has ever before been attempted in any language.

V. GORDON CHILDE.

The Study of Corals.

An Introduction to the Study of Recent Corals. By Prof. Sydney J. Hickson. (Publications of the University of Manchester, Biological Series, No. 4.) Pp. xiv+257. (Manchester: At the University Press; London: Longmans, Green and Co., 1924.) 25*s*. net.

AMONG living zoologists no one is more competent than Prof. Hickson to write a book on corals. Many years ago he made acquaintance with coral organisms in their natural surroundings; and since then the Anthozoa, the group to which most corals belong, have been one of the chief objects of his study. Those, therefore, who already know his lucid and attractive manner of writing will be prepared to expect an authoritative and fascinating work; and they will not be disappointed. But first one or two small criticisms.

The author's definition of the word "coral" will probably excite surprise by its breadth. He uses it for marine sedentary organisms, animal and vegetable, "that produce a solid skeletal (or more accurately *shell*) structure of calcium carbonate which persists as such entire, after the death of the living organisms that produced it." The things included in the term corals are therefore the calcareous marine plants, certain Foraminifera and sponges, the madreporarian corals, certain Alcyonaria (such as the precious coral) and Hydrozoa, and also some genera belonging to the Polyzoa and Annelida. But has the term coral ever been used, even popularly, in such a wide sense as this? In practice Prof. Hickson widens it still further by including Gorgonia and the antipatharians, the skeleton of which is not calcareous at all. Parenthetically, would the skeleton of the precious coral ordinarily be termed a shell structure, and is it "strictly speaking, an outside support or exoskeleton" (p. 17)?

We shall not quarrel very seriously, however, with the definition proposed by the author. He has had the happy idea of describing for us, in an easy and delightful fashion, a number of organisms which have interested him, and of illustrating his descriptions by choice examples of the photographer's art. He is in want of a term under which these can be subsumed; and "coral" is at least not altogether inappropriate—is as suitable, at any rate, as any single word can be.

One other objection to the author's use of terms. We shall not all agree that "the conception of individuality has no relation to the structure or function of the parts but to the discontinuity of the living organism as a whole from other living organisms"; though it may perhaps be true that "the Alcyonium or the Tubipora as a whole is, *in common language* (italics the reviewer's), the individual, and the polyps parts or organs of the individual."

Coming to the contents of the volume, the introductory chapter, "On the Use of some Words," deals with the meaning of "coral" and "individual," which we have just alluded to, to that of "polyp" (which Prof. Hickson extends to the zooids of the Polyzoa) and "zoophyte." Chap. ii. gives a short account of structure, especially of that of an anthozoan polyp, and classification; to it is appended an interesting "Additional Note on the Nutrition of Corals," discussing the part played by symbiotic algæ. Chaps. iii. and iv. (pp. 23-102) deal with madreporarian corals; this, the backbone of the subject, is attractively treated in a simple style and in clear language, made even clearer by diagrams and by exquisite reproductions of photographs (we dare not, in this journal, imitate Prof. Hickson (p. 190) and write photos) of the actual objects. It is confusing and contradictory, however, to state,

of the mesenteric muscular bands, that "in the cases of the directive mesenteries these ridges are on the surfaces *opposed to each other* (italics the reviewer's), that is to say, they face outwards" (p. 33). The interesting association of Heterocyathus with the gephyrean Aspidosiphon is described on pp. 39-40.

Alcyonarian corals are described in Chap. v., Corallium, Tubipora, Heliopora and Gorgonia are treated at some length, a number of other genera more cursorily. Chap. vi. disposes of the antipatharians in a few pages; and successive chapters are given to the hydrozoan corals—Millepora and the Stylasterina; polyzoan corals; foraminiferan and poriferan (Merlia) corals and annelid worm tubes, and lastly coral Algæ—the red seaweed corals and green seaweed corals.

The penultimate chapter is something of a disappointment. We feel that in a volume on corals by Prof. Hickson we had a right to expect more than 17 pages on coral reefs; we would willingly have sacrificed the worm tubes, sponges, and Foraminifera, as well as the Algæ, to have had an equivalent here. The author's very first words—the opening sentences of the preface—speak of the fascination, the charm, and the enduring interest of the life of the reefs; but he gives us little more than a brief account of the composition and form of the reefs, and of the theories of their formation.

The last chapter gives an agreeable account of the trade in black and red coral from the earliest times. Among much other interesting information we are told that some years ago a great bronze shield, supposed to belong to the Early Iron age, was found in the bed of the river Witham in Lincolnshire, bearing five large pieces of red coral, each circular in outline, ground to form a convex surface and polished; and that armour decorated in a similar way has also been found in Ireland. Even in the eighteenth century red coral was much esteemed as a drug, being given, for example, in a paste along with crabs' eyes and other things, for fevers in children.

The book is obviously intended to be of use to the intelligent layman, who has only the most elementary acquaintance with physiology and anatomy. But it will certainly be read largely by others; not only by elementary but also by advanced and honours students of zoology who are making a special study of the Anthozoa. For these, as well as for zoological amateurs, it will be a delightful occupation to go round the cases of the Manchester Museum, or of the British Museum, with Prof. Hickson's book in hand. We congratulate the author on his accomplishment; would that all zoologists, before the conclusion of their active life, would give us similar accounts of the groups which have formed the subject of their researches.

Morphology of the Alimentary Canal.

Vorlesungen über vergleichende Anatomie. Von Prof. Otto Bütschli. Lieferung 4: Ernährungsorgane. Herausgegeben von F. Blochmann and C. Hamburger. Pp. iv+380. (Berlin: Julius Springer, 1924.) 6·45 dollars.

THIS is a compilation of a kind which we expect from the patient industry and passion for orderly arrangement of the German scientific writer. It is a mine of information from which details of the structure of the alimentary canal of a very large number of animals can be extracted with a minimum of trouble. To the English zoologist it will appeal most because it is illustrated with the thoroughness which the German author rightly believes to be necessary, and the illustrations are selected with characteristic care. A large proportion of them are entirely new to text-books, and many of them are from original drawings of Bütschli. But for the fact that they are sometimes rather too small to be easily understood, they are really excellent and a substantial justification for the publication of the book.

When we consider the text, however, there arises the question as to how far a morphological encyclopædia of this kind is valuable to zoologists. It has, indeed, occurred to the authors that a certain amount of physiological information should be incorporated into their work. This is, however, relegated to paragraphs of small print for the most part and, even making allowance for the scantiness of present-day knowledge, is insufficient. The alimentary canal lends itself less to purely morphological comparisons than any other system of the body. It is so plastic that astonishing differences may exist between closely related animals which are obviously related to differences in diet. To take an example, the excellent morphological account of the alimentary canal of the Mollusca seems incomplete to the reviewer because the varied habits and physiological characters of such forms as nudibranchs, heteropods, boring lamellibranchs, and many others are never mentioned. The initiated may be able to fill up the gaps, but there is not much help for the student who wants to know how much of the form is related to function. Nor is there usually more than casual reference to the histology of the various alimentary organs. This is no doubt outside the scope of the work, but it may well be claimed that, in the study of the alimentary system, histology is as indissolubly connected with gross anatomy as physiology.

It is surprising to find that there is practically no introduction and no general summary, which is sorely

morphology and comparative physiology as well (like the stupendous Winterstein) do everything but compare. They present an array of densely marshalled facts through which the reader travels despairingly, being quite unable to see the wood for the trees.

Pottery and Porcelain.

Pottery: being a Simple Account of the History of Pottery and a Description of some of the Processes employed in its Manufacture. (Pitman's Common Commodities and Industries.) By Charles J. Noke and Harold J. Plant. Pp. xi+136. (London: Sir Isaac Pitman and Sons, Ltd.) 3s. net.

Pottery and Porcelain: a Handbook for Collectors. Translated from the Danish of Emil Hannover Edited with Notes and Appendices by Bernard Rackham. Vol. 1. Europe and the Near East: Earthenware and Stoneware. Pp. 589+7 plates. (25s. net.) Vol. 2. The Far East. Pp. 287+2 plates. (18s. net.) Vol. 3. European Porcelain. Pp. 571+2 plates. (25s net.) (London: Ernest Benn, Ltd., 1925.)

THE first-mentioned of these works might, happily, serve as an introduction and technical aid to the important and comprehensive handbook with which it is associated in this notice. Its authors have accomplished their modest scheme with such ability and success as to give the reader who is not a potter an insight into the practical methods which are followed in the manufacture of the multitarious articles of pottery and porcelain, whether intended for everyday use or as the embodiment of precious artistry, which men treasure in our day even as they seem to have prized and collected such things for unnumbered years. The clarity and simplicity with which the technical information is presented -together with excellent illustrations and photographic reproductions of the tools, methods, and processes used by the Staffordshire potters of our time—deserve warm commendation. Apart from the immediate aim of the writers, which has been to aid the student-workman who is engaged in the craft, every collector of pottery and porcelain who wishes to acquire clear ideas of how the precious objects he treasures were made will find this a handy and reliable little work of reference, to be used in conjunction with those voluminous histories of the potters' achievements in which technical matters are not always treated with such simplicity and precision.

The scholarly and comprehensive handbook for collectors compiled by the late Dr. Emil Hannover and now translated for English readers by Mr. Bernard Rackham, one of our foremost museum authorities—[illegible] contributes greatly to the value of this English edition by an extensive series of explanatory notes and addenda—displays at once the strength as well as the weakness of any survey, aiming at completeness, of such an extensive field by any single author. Undoubtedly, Dr. Hannover's narrative gains in unity of purpose and of outlook because all the ideas have been distilled through the alembic of a single, well-informed mind. It is, however, almost inevitable that certain sections of any work that proposes to set forth the complete history of an artistic craft that is coeval with civilisation, which must therefore comprehend all the fictile arts of the Greek, Persian, Chinese, Japanese, and European peoples—to mention only the more important—should be less satisfactory in judgment and understanding than others. Having entered this modest *caveat*, the reviewer is free to appreciate the fare so abundantly set forth for the reader's delectation and instruction.

It is only possible in the space at our disposal to direct attention to the more salient features of the work, for as a comprehensive bibliography of ceramic literature is included, the reader who requires fuller information on any specific point will readily find the most authoritative sources to which he may turn for further enlightenment. Another feature, which adds to the completeness of the work and its consequent value to collectors, especially to those who have but recently acquired that delightful hobby, is the valuable descriptive notes and illustrations of "forgeries"; for though, as Dr Hannover says, "the really dangerous counterfeits can only be distinguished by acquiring a thorough knowledge of the genuine things," it is possible to prepare one's self for meeting the spurious thing and its recognisable defects.

It seems but natural that one should instinctively turn to the volume which deals with the ceramic productions of the Far East, especially as for the last two centuries these Oriental wares have exercised such a powerful influence on all European pottery and porcelain, with the exception of the stonewares. In the few years that have elapsed since the close of the War, all competent observers must have been impressed with the number of artist-potters, working on their own account or in association with old-established factories, in all European countries, who have turned with a fresh, often a childlike eye to the older treasures of Chinese and Japanese skill and are now exhibiting their pleasure by the production of works which, though frankly European in style, are not ashamed to acknowledge the sources of their technical inspiration.

In the same way, Dr. Hannover, having absorbed all that has been written by the foremost authorities, gives us a condensed but eminently readable account of the growth and development of the ceramic arts in

The
LABOR PROBLEM
IN THE
UNITED STATES

By

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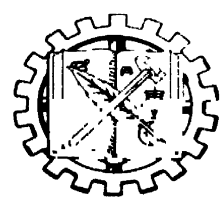

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